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TRAUMATIC SHOCK

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THE literature and findings to be reviewed apply more particularly to the delayed or secondary shock which may follow trauma. Many of the findings and symptoms of this type of shock appear to be the result of a peripheral circulatory insufficiency resulting from a decrease in the effective blood volume. A distinction between primary and secondary traumatic shock appears to be necessary because the former, occurring at the time of injury, is thought to be neurogenic in origin, resulting from the reflex vascular effects of pain and psychic stimuli. When speaking non-specifically of shock, one usually refers to the secondary type, and most of the experimental work on shock has been directed toward an understanding of its etiology and mechanism.

The following changes in the blood and circulation are generally agreed upon as occurring in traumatic shock:

1. Capillary stagnation, which leads to reduction of the effective blood volume (oligemia), as evidenced by:
   a. Hemoconcentration
   b. A decrease in venous return to the heart with a resulting reduction in cardiac output
   c. A decrease in circulating blood volume by exemia
2. Decreased tone of skeletal muscles, decreased arterial pressure, collapsed veins, and depressed respiration
3. Anoxemia
4. Decrease in the alkali reserve (sodium bicarbonate) of the blood (acarbia)
5. Partial compensation for the tendency to acidosis by a reduction in the carbonic-acid content of the blood (acapnia)
6. An actual decrease in the pH of the blood (acidemia or hyperhydria), which results because of the fact that there is only partial compensation for the acidosis
7. A rise in the plasma potassium, which is interpreted as an indication of a disturbance in cell permeability

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PHYSIOLOGICAL EXPLANATION OF THE CIRCULATORY CHANGES OCCURRING IN SHOCK

For a long time, the decided fall in blood pressure was regarded as the primary feature of shock and attention was directed to determining its cause. There are three general ways in which blood pressure may fail:

1. Myocardial failure. The following evidence indicates that myocardial failure does not occur in shock:
   a. The heart continues to beat vigorously after respiration has ceased.
   b. If the heart of a shocked animal is supplied with adequate fluid, the blood pressure may be returned to normal or above normal (300 mm. of Hg in dogs) (15, 57, 63).
   c. Direct observation of the heart in shocked animals shows it to be beating vigorously although propelling little blood because of deficient venous return (20, 21).
   d. The veins are collapsed in shock while in myocardial failure they are distended (46).

2. Decreased peripheral resistance; vasomotor exhaustion. The bulk of evidence is against this factor as playing a primary rôle in shock, although it may play some part:
   a. Vasomotor reflexes, both pressor and depressor, are unimpaired in the shocked animal (71, 72). This does not prove that vasomotor tonus is not depressed. The reflex vasomotor activity which exists in early shock may be different from the continuous vasoconstrictor tone of this center.
   b. Arterial resistance to perfusion is maintained or even increased in the early stages of shock (27).
   c. Early in shock there is a decreased venous return to the heart and a diminished minute output, yet there is no fall in the blood pressure. This would indicate an increased activity of the vasomotor system (46).
   d. The arterioles in shock are in a state of maximal contraction (28, 56, 80).

      The last three statements point to the presence of vasoconstriction in shock, and for this reason it is argued that epinephrine, ephedrine, and synephrine should not be used. However, there are several types of "shock" in which these pressor drugs are useful: namely, barbiturate poisoning, anaphylactic shock, and shock following section of the splanchnic nerve, excision of the celiac ganglion, or splanchnic congestion (48).
   e. Sympathectomized animals survive in good condition without a vasomotor system (14, 46).
3. Reduction in blood volume (actual or effective blood volume)

It has been definitely established and repeatedly confirmed that a marked decrease in the effective blood volume is an outstanding feature of shock regardless of the method by which shock is produced (35, 51, 74).

From the foregoing considerations it appears that the fall in blood pressure in shock results from a decrease in the effective circulatory volume. Vasomotor failure may play a part in some types of shock, but in no instance of uncomplicated shock does the blood-pressure decline appear to be due to cardiac failure.

One may look upon the circulatory insufficiency of shock as a manifestation of an uncompensated imbalance between the volume of blood and the volume capacity of the vascular system. According to Moon (67), this may occur in two ways:

1. Reduction in blood volume
   a. Directly, as in severe hemorrhage
   b. Indirectly, (1) by transudation of plasma (exemia) through capillary walls into tissues, or (2) through perspiration, vomiting, and diarrhea
2. Increase in the volume capacity of the vascular system

If the entire capillary stream bed of the skeletal muscles alone were open simultaneously, the volume capacity would about equal the normal blood volume of the body. Other visceral organs have a similar potential capacity (53).

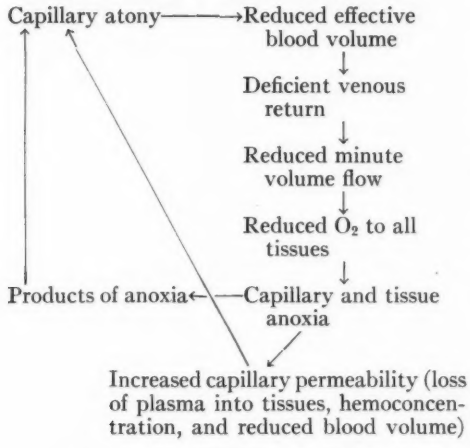
From the evidence available at present, it appears reasonable to suppose that the following sequence of events occurs in shock (46, 64, 67):

1. Stagnation of blood in the capillaries. This increases the volume capacity of the vascular system and leads to a reduction in the effective circulatory volume.
2. A reduction in the venous return to the heart, hence a reduction in cardiac output.
3. Anoxia results from the capillary stasis and reduced cardiac output. Increased capillary permeability results from the anoxia and there is a loss of colloids and fluid from the blood.
4. A loss of blood plasma into the tissues causes an actual reduction in the circulating blood volume. It also causes the hemoconcentration characteristic of shock.
5. There is thus set up a self-perpetuating vicious cycle (see diagram) which leads eventually to a peripheral circulatory failure and shock.
6. Early in shock, compensatory vasoconstriction maintains the blood pressure near its normal level. The vasoconstriction further decreases the volume flow into the capillaries and by so doing may actually aid the development of anoxia. Later, the venous return and cardiac output become so small that the most extreme contraction of the arterioles is unable to maintain arterial pressure. Also, in the later stages, anoxia of the vasomotor center causes vasomotor failure. The evidence indicates that capillary stasis, reduced venous return, reduced cardiac output, and hemoconcentration occur before there is any evidence of vasomotor failure.

According to this description, there seem to be two major factors involved in the production of shock (46, 64, 67):

1. Capillary atony and stasis
2. Anoxia

Either factor alone brings the other into operation and sets up a self-perpetuating cycle. The following diagrammatic presentation of the sequence of events is modified from Moon (64, 67):


Capillary atony
Reduced effective blood volume
Deficient venous return
Reduced minute volume flow
Reduced O_2 to all tissues
Capillary and tissue anoxia
Products of anoxia
Increased capillary permeability (loss of plasma into tissues, hemoconcentration, and reduced blood volume)

THEORIES PROPOSED TO EXPLAIN THE ETIOLOGY OF SHOCK

What fundamental factor attendant upon severe trauma or surgical operations leads to the clinical condition known as traumatic or surgical shock? Any acceptable theory must be compatible with the sequence of events which have been listed if one accepts these facts and their sequence as correct. Some of the many theories proposed will now be considered:

I. *Vasomotor exhaustion theory* (17, 18, 19). According to this theory, exhaustion or paralysis of the vasomotor center occurs as a result of its bombardment by sensory impulses from the traumatized area. Evidence has already been considered which indicates that vasomotor exhaustion is not the primary cause of shock.

II. *Acidosis theory.* It is quite generally agreed that there is a decrease in the alkaline reserve in traumatic shock and the question arises as to whether this is a primary feature. Since the intravenous injection of acids sufficient to reduce the alkaline reserve to a very low level (severe uncompensated acidosis) fails to produce shock, this cannot be the primary cause but is a secondary complication, at least partially due to the accumulation of lactic acid caused by the anoxia (59, 62, 67, 70, 83). Others (39, 40, 41, 42, 43, 46) prefer to call the reduced alkali reserve which occurs in shock "acarbia" and point out that the acarbia which occurs at high altitudes, in acapnia, in carbon-monoxide asphyxia, and in traumatic shock is not truly acidotic in type. Henderson (46) points out the fact that in simple acidosis, such as is produced by the injection of acid, by the feeding of ammonium chloride, and by nephritis, or that associated with diabetic coma, the inhalation of carbon dioxide is definitely harmful and may be fatal; but if acarbia is due to shock, hyperventilation, or carbon-monoxide asphyxia, carbon-dioxide inhalation raises the blood bicarbonate and is of definite benefit. He regards the acarbia of shock as the result of acapnia and considers the lactic-acid accumulation as unimportant in its production.

III. *The acapnia theory* (38, 39, 40, 41, 42, 43, 46). According to this theory, failure of the circulation (shock) is brought about by a failure of the venopressor mechanism (the mechanism which is responsible for the venous return to the heart) as a result of a decrease in the carbon-dioxide content of the blood. Hyperpnea induced by painful stimuli, anesthesia, or emotional excitement, together with a direct loss of carbon dioxide by visceral exposure, results in a decrease in the blood carbon dioxide (acapnia). This in turn leads to a depression of the motor centers in the spinal cord responsible for the maintenance of tone in skeletal muscle and results in hypotonia and flaccidity. Muscular tone and intramuscular pressure are regarded as essential features of the venopressor mechanism. Hypotonia results in a stagnation of blood in the capillaries and failure of the venous return. Also, the acapnia depresses respiration and the respiratory component of the venopressor mechanism becomes less effective. Finally, the decreased carbon-dioxide content of the blood results in a migration of alkali and fluid into the tissues and leads to acarbia ("acidosis"—reduced alkali reserve) and to oligemia. Supporters of this conception have shown (44, 46) that carbon dioxide has a powerful influence on venous pressure, whereas it exerts relatively little direct influence on arterial pressure. They have measured intramuscular tension and found that it is decreased in patients several hours after major surgical procedures, in wound shock, and in hyperventilation; whereas it is increased by carbon-dioxide inhalation and by the administration of strychnine (3, 45, 46, 52). It is claimed that shock produced by excess of curare, by spinal anesthesia, and by transection of the spinal cord is fundamentally due to loss of muscle tone with failure of the venous return.

In many ways this conception is an attractive one. It is compatible with the facts given above. However, others have been unable to produce shock by hyperventilation. Janeway and Ewing (49) produced shock by manipulation of the in-

testine in animals in which the blood carbon dioxide was kept constant by supplying the gas through a tracheal cannula. Moon's (65, 67) postmortem observations have shown that most of the stagnation occurs in the visceral capillaries rather than in those of the skeletal muscle. Cannon (15) claims that there is insufficient hyperpnea in wound shock to be of any importance, but Henderson points out that an increase of breathing to twice the normal value is scarcely observable.

IV. *The theory of traumatic toxemia* (11, 12, 13, 15, 16, 60, 61, 65, 73, 89, 90). This theory was the outgrowth of the observations made by the Special Committee on Shock, a division of the British Medical Research Committee, during the first World War. Briefly stated, it postulates that traumatic shock is caused by a toxin absorbed from injured tissue. The evidence upon which it is based is chiefly circumstantial. For example, it was observed that shock appeared gradually after wounds, that the greater the damage the greater was the shock, that anything checking absorption from the injured area delayed the appearance of shock (for example, (61, 73) a tourniquet—the removal of which was promptly followed by shock), and that removal of injured tissue by débridement or amputation brought improvement. In the laboratory, the theory was apparently supported by experiments in which a limb was traumatized without results as long as its artery and vein were ligated, but on removal of the ligatures, shock developed at once. A few years prior to the war, Dale and Laidlaw (21) had reported on the pharmacological action of histamine. Since this amine produced a picture similar to that of shock, it was at once suggested that histamine or an histamine-like substance was the etiological agent. Much of the subsequent investigation has been concerned with a detailed comparison between the phenomena of traumatic shock and those of toxemic shock produced by histamine or similar substances.

Direct crucial evidence in support of this theory is lacking. The question as to whether toxic substances can be extracted from traumatized tissue or are present in the blood coming from a traumatized area has given rise to a very controversial literature, but the most convincing evidence is against it (4, 5, 16, 47, 60, 68, 69, 82). Phemister (69) obtained no vasodilator effects when blood from the traumatized leg of one dog was collected in a viviperfusion flask and injected into another dog. O'Shaughnessy and Slome (68) perfused the traumatized limbs of shocked cats and were never able to obtain a perfusate that had any toxic effects. Dragstedt and Mead (26) were unable to find any vasodepressor toxin in the blood and lymph of dogs during experimental surgical shock. Smith (82), Parsons and Phemister (69), and Roome and Wilson (77) were all unable to confirm the findings of earlier workers who had obtained toxic extracts from injured tissue.

It is difficult to interpret certain of these experiments. For example, the failure of shock to appear following trauma to an extremity in which the vessels had been ligated is attributed by supporters of the toxemia theory to be due to the prevention of absorption of toxin from the injured limb; supporters of the theory of local fluid loss say that shock did not develop because ligation of the vessels had prevented local loss of fluid; and, finally, those who believe shock is due chiefly to nervous-reflex phenomena say that shock did not develop because the ischemia produced an anesthetic limb and thus prevented the operation of nervous reflexes.

To summarize, the theory of traumatic toxemia is at present based upon circumstantial evidence. No one, up to the present time, has convincingly demonstrated the existence of such a toxin by direct methods.

Recently, Moon and Kennedy (65) have produced shock by the introduction of a piece of normal and presumably sterile muscle into the peritoneal cavity of a healthy animal. Moon and his associates (66) have also produced shock with high-voltage abdominal x-rays delivered to the abdomen. These results are interpreted in support of the toxemia theory.

V. *The adrenal theories of shock* (12, 32, 33, 86, 87). At least three distinct theories have been suggested which assign a major rôle to the adrenal glands in shock:

1. Lack of epinephrine secretion leads to a peripheral vasodilatation and the shock syndrome. The following evidence indicates that the theory is untenable:
   a. The peripheral vessels (arterioles) are not dilated (27, 28, 46, 56, 57, 80).
   b. Adrenalin secretion is unaltered during shock (Stewart and Rogoff, 75, 76).
   c. Complete loss of epinephrine secretion does not produce shock (Stewart and Rogoff (83a).
2. Hyperactivity of the sympatho-adrenal mechanism excited by pain, emotion, or tissue irritation may result in a prolonged arteriolar constriction. This eventually produces capillary and tissue anoxia and thus initiates the vicious cycle of shock. This theory was supported by the following evidence:

a. There appeared to be an increase in the blood epinephrine content in shock (Bedford, 2).
b. In decerebrated cats exhibiting sham-rage (hyperactivity of sympatho-adrenal system), there is a decreased blood volume, capillary stasis, and hemoconcentration. If ergotoxin is given, which paralyzes the thoracolumbar constrictors, these effects are not observed. Also, cats that have been previously sympathectomized do not show these changes (Freeman, 32).
c. Slow infusion of epinephrine over a period of hours can produce shock (Freeman, 32; Bainbridge and Trevan, 1; Erlanger, Gasser and Meek, 26a, 35).

The following evidence appears to oppose this explanation:

a. Such quantities of epinephrine as are necessary to produce shock in experimental animals never exist as a result of stimulated adrenal activity (35, 63, 64).
b. Adrenalectomized animals maintained on cortical extract can readily be thrown into shock by the usual methods (Swingle, 86, 87).
c. Shock may be produced in sympathectomized animals as easily as in normal animals (Freedlander and Lenhart, 31).

The evidence derived from such studies indicates that the phenomenon of shock can be produced by a prolonged vasoconstriction apparently as a result of anoxia. This is supported by the experiments of others in which the circulation was retarded mechanically by adjustable clamps on the aorta or vena cava for varying periods. When these clamps were removed, shock developed (Janeway and Jackson, 50; Erlanger, Gesell, Gasser, and Elliot, 28).

The opposing evidence cited appears to eliminate sympatho-adrenal hyperactivity as an essential factor in the development of shock, or at least in the development of experimental shock in the anesthetized animal. This does not prove, however, that such a mechanism may not contribute at least in part to the development of traumatic shock in man. An anesthetized animal is not comparable to an excited, conscious soldier. It is hard to believe that nervous factors do not play at least some part in the latter instance (63).

3. Shock is due to adrenocortical insufficiency, i.e., a lack of the cortical hormone. Since adrenalectomized animals show a form of circulatory failure very similar to that of shock, and since injections of cortical hormone produced recovery in animals practically moribund as the result of profound surgical shock, adrenocortical insufficiency was suggested (Swingle, Pfiffner, 86, 87).

A detailed comparison between the physiological changes in traumatic shock and those found in adrenocortical insufficiency reveals many similarities (87):

a. Reduction in the blood volume, cardiac output, and volume flow
b. Hemoconcentration
c. Increased cardiac rate, decreased arterial and venous pressures
d. Diminished renal function. Low basal metabolic rate, low body temperature
e. Active vasoconstriction. Normal cardiac capacity
f. Acapnia and acarbia
g. Increase in blood potassium. Decrease in sodium and chloride
h. Abnormal sensitivity to cold, anesthetics, toxins, infections, hemorrhage, and trauma

The mechanism of death in adrenocortical insufficiency is not yet established. However, cortin is believed to affect the permeability of cells, to regulate capillary tonus, and perhaps to exert some specific effect on the kidney tubules. It is, therefore, important in the regulation of water and salt balance and a deficiency leads to anhydremia, hyponatremia, hypochloremia, and hyperkalemia. Some think death is due to potassium poisoning (88, 93) or to loss of potassium from the cells (37, 58).

Recently, Scudder (79) has emphasized that one common denominator in shock, whether produced by tissue abuse, fluid loss, hemorrhage, the injection of toxins, adrenocortical destruction, or sympathetic stimulation, is a rise in plasma potassium. He does not conclude, however, that shock is due to potassium poisoning alone.

According to Moon (67) one major objection to the adrenal deficiency theory is the element of time. The average survival period after a skillfully performed adrenalectomy is ten days for dogs, and twelve days for cats. Moreover, the animals are apparently in perfect health until from one to three days before death. If an adrenalectomized animal which has been maintained by injections of cortin is suddenly deprived of this substance, shock does not develop immediately,

but only after several days. If, then, shock is due to a partial or even total inhibition of adrenocortical function incident to trauma, one would not expect shock to develop until after several days (seven in dogs, nine in cats). Actually, experimentally produced shock develops in an hour or so; clinically, shock appears usually within four hours and almost always within twenty-four hours following severe trauma (64).

The fact that adrenocortical inhibition may not actually be the cause of shock should not be interpreted to mean that cortical extract should not be used in its treatment. Shock and adrenocortical insufficiency show very similar physiological changes. If cortin aids in correcting these changes, it should be of therapeutic value in the treatment of shock. Moreover, it has been pointed out (Swingle) that adrenalectomized animals are abnormally sensitive to agents which produce shock only with difficulty in normal animals. This suggests that the normal animal has a higher "shock-threshold." It may be that shock produced in a normal animal, although not due to adrenal insufficiency *per se*, may be aided in its development by a relative deficiency of cortical hormone. Or, in other words, the normal amount is insufficient to protect against the added demands of trauma. Perhaps by supplying cortin artificially, one may raise the patient's "shock-threshold."

VI. *The theory of local fluid loss* (5, 6, 7, 8, 10, 31, 47, 69, 82). This theory states that extravasation of blood and fluid into the injured tissues is a sufficient explanation for the decreased blood volume and the fall in blood pressure in traumatic shock (Blalock, 5, 6, 7, 8, 10; Parsons and Phemister, 69; Freedlander and Lenhart, 31; and Holt and MacDonald, 47). The evidence offered in support of this theory is both direct and indirect:

1. The indirect evidence tends to exclude the toxemia theory and to eliminate nervous factors.
   a. Massage of a traumatized limb did not aggravate shock. The removal of tourniquets did not further its development (Phemister). (Note that opposite results are reported by supporters of the toxemia theory.)
   b. The presence of a toxic substance in extracts of traumatized tissue or in the blood coming from the traumatized area could not be demonstrated.
   c. Shock was produced by trauma to a denervated limb as easily as by trauma to a normal limb (Phemister; Holt and MacDonald, 47; Freedlander and Lenhart, 31). (Note that this result is directly contradicted by Simonart (81), and by O'Shaughnessy and Slome (68), who found that denervation of the limb or spinal anesthesia prevented the development of shock.)
2. *Direct Evidence.* Experiments were performed in which shock was produced by trauma to a limb. After the death of the animal, the weight of the traumatized limb was compared to that of the other. The difference in weight was taken to represent extravasated blood and fluid in the traumatized areas. This was then calculated and averaged 35 per cent of the total blood volume in Blalock's experiments. It was found that control dogs died of circulatory failure when corresponding amounts of blood had been withdrawn. From this it was concluded that the phenomenon of shock could be adequately explained on the basis of local fluid loss at the site of trauma.

Comment. Moon (67) pointed out a factor of error in such experiments when the difference in weight of the traumatized and normal limb is taken to represent fluid lost in the injured area. Obviously, the fluid accumulated in the injured area collects at the expense of other parts of the body so that at least part of the weight difference represents fluid lost from the opposite limb. Thus such calculations give results which are too high. Other workers (O'Shaughnessy and Slome, 68) have found that shock occurs readily when only 20 per cent of the blood volume is lost into the leg, and that the amount of blood which must be lost by hemorrhage to produce circulatory failure averages close to 50 per cent.

Moreover, although Blalock reported a concentration of the blood in his experiments, others (Phemister, 69; Freedlander and Lenhart, 31) observed a dilution of the blood. At necropsy, Phemister's animals showed findings typical of hemorrhage. In view of these facts, it would appear that these workers were dealing primarily with hemorrhage.

That local fluid loss is important in shock cannot be denied. Anything that decreases the blood volume is important. However, the evidence available at present does not justify the conclusion that this is the entire explanation.

INTRAVENOUS FLUIDS OF PARTICULAR VALUE IN THE TREATMENT OF SECONDARY SHOCK

The restoration and maintenance of an effective blood volume are of greatest importance in the treatment of secondary shock. For this purpose, solutions of crystalloids are of inferior value be-

cause of their diffusibility. Experimental (36) and clinical (85) studies have shown that solution of acacia injected intravenously may result in liver damage and decrease the oxygen-carrying capacity of the red blood cell. Fresh, compatible blood administered promptly and in adequate amounts appears to be the ideal fluid for restoring the blood volume. Instances in which excessive hemoconcentration has occurred may be exceptions in which serum or plasma are preferable fluids for the restoration of an effective circulation. Recent studies (22, 23, 24, 78) on the effect of storage upon the composition of blood have demonstrated an increase in plasma potassium with most methods of preservation. The importance of this increase in blood used for combating shock, a condition in which the plasma potassium may already be elevated (91, 92), has been pointed out by Scudder (78). DeGowin, Hardin, and Harris (22) observed no ill-effects in 14 subjects transfused with blood stored from nine to twenty-four days and containing increased quantities of plasma potassium. They concluded that the high content of potassium in blood stored for thirty days is not toxic for human beings if transfused at a velocity of less than 43.3 c.cm. per minute. The plasma potassiums of their patients were all essentially normal before and after the transfusion. Apparently none of these patients were in shock or had any condition which might cause a hyperkalemia.

Numerous studies have been made of the efficacy of plasma and serum in combating and preventing shock, both lyophile and fresh plasma having been used in such studies. The preservation of immune substances for an indefinite length of time has been accomplished by the freezing and desiccation (lyophile treatment) of fresh sterile serum or plasma (29, 30). Such desiccated serum or plasma can be readily redissolved and may be administered either in a concentrated form or in its original volume of fluid. Clinical (55) and experimental studies (9) give favorable reports as to the effectiveness of lyophile serum in the restoration of blood pressure in secondary shock. A study (34) on the effectiveness of lyophile serum (4 times concentrated) upon the blood volume of normal dogs showed that it increased the blood volume by drawing fluid from the extravascular reservoirs. The use of citrated plasma in the treatment of secondary shock is reported by Strumia, Wagner, and Monaghan (84), who consider it an ideal means of restoring an adequate circulation in shock. They state that the advantages offered by citrated plasma are:

a. It can be readily prepared and safely transported.
b. It can be stored for an indefinite period of time (by means of the lyophile treatment).
c. It is entirely safe and free from reaction (less likely to react than serum).
d. It can be used in large and repeated doses.
e. It is ready for instant use.
f. It does not add to the concentration of erythrocytes if this condition is present.

These workers as well as others (54) indicate that cross-matching with the recipient's blood is unnecessary; however, Mahoney (55) recommends that the redissolved serum be cross-matched with the recipient's cells.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Spencer, F. R., Hegner, C. F., and Black, W. C.: Benign and Malignant Tumors of the Jaw. *Arch. Otolaryngol.*, 1940, 32: 200.

Of the 19 cases reported, 15 were malignant tumors and 4 benign tumors. The ages of the patients ranged from two weeks to eighty-one years. The average age was forty-nine years plus. There were 4 patients of the ages of two weeks, two years, eight years, and sixteen years, respectively. Three patients were female and 16 male, which finding corresponds with the more frequent occurrence of malignant disease in males. In 13 cases a clinical diagnosis of carcinoma was made. One patient had a basal-cell carcinoma on one side of the jaw and a squamous-cell carcinoma on the other. In 10 cases roentgen therapy was given one or more times during the course of the disease. Only 8 patients were operated on, as in many cases the tumor was inoperable. All those with malignant tumors were made more comfortable and their lives prolonged by radium and roentgen therapy.

JOSEPH K. NARAT, M.D.

Patey, D. H.: The Treatment of Mixed Tumors of the Parotid Gland. *Brit. J. Surg.*, 1940, 28: 29.

The present article regarding the treatment of mixed tumors of the parotid gland is based partly on the experience of others as revealed in the more recent literature, and partly on cases from the surgical and radiological records of the Middlesex Hospital.

A very important question is the risk of complications, particularly of spontaneous malignant change, during the course of the gradual increase in size of the tumor. It has frequently been asserted, chiefly as a justification for early surgical intervention, that such spontaneous malignant change is common. The author knows of no reported case of carcinoma of the parotid in which the evidence is complete that it developed from a mixed tumor, though it may justly be argued that the carcinoma may destroy the evidence of its origin. This type of possible malignant change in a mixed tumor must therefore be regarded at present as non-proved. The other type of possible malignant change—the taking on of characteristics of malignancy, particularly in the form of widespread local infiltration without change of histological type—is well established.

As a result of the author's analysis his conclusions and present position of the treatment of mixed parotid tumors may be summarized as follows:

The natural course of mixed parotid tumors is to increase in size at varying rates, which leads to a corresponding degree of deformity, but otherwise causes very little disability. Spontaneous malignant change in a mixed tumor is so rare that for practical purposes it may be ignored. Surgical enucleation alone may be satisfactory, but in too high a proportion of cases to be regarded with equanimity recurrence occurs, and in some cases such recurrence leads directly to the death of the patient. There should be no hurry to treat these tumors. A period of observation to determine the rate of growth may be advantageous. In mixed parotid tumors appearing late in life, and in slowly growing tumors appearing earlier, the correct treatment may be to do nothing. Radical excision of the parotid gland is too deforming to be a routine treatment of mixed parotid tumors. There may, however, be exceptional cases in which it is the correct treatment, and in which the price of complete facial palsy is a justifiable one for the patient to pay. Irradiation alone is not a satisfactory form of treatment. It may, however, be a useful diagnostic measure. Pre-operative irradiation is valuable since it renders the capsule of the tumor tougher and less liable to rupture during operation. Enucleation followed by irradiation is on present evidence the best active treatment for mixed parotid tumors.

JOSEPH K. NARAT, M.D.

EYE

Morgan, O. G.: Some Cases of Traumatic Myopia. *Brit. J. Ophth.*, 1940, 24: 403.

After direct trauma to the eye, one not infrequently notes the development of myopia with or without actual damage to the lens itself.

According to the intensity of the injury one can distinguish four different types:

1. That due to spasm of the ciliary muscle associated either with spasm of the sphincter of the pupilla, or with traumatic mydriasis. In these cases from 1 to 4 diopters of myopia may appear, which last a few days, as a rule, and then disappear without treatment or under treatment with atropine.

2. That due to partial rupture of the fibers of the suspensory ligament of the lens associated with iridodonesis. This may be responsible for from 5 to 6 diopters of myopia which is often permanent, and does not disappear under treatment with atropine.

3. That due to changes in the lens itself. This is often variable in amount and may be associated with astigmatism.

4. That due to more serious damage to the anterior or posterior coats of the eye, which presumably has caused some axial lengthening.

Cases of injury associated with rupture of the suspensory ligament and iridodonesis are not un-

common. There are probably two factors in the production of myopia.

1. The more anterior position of the lens itself.
2. The fact that the lens in these circumstances becomes more globular.

In congenital dislocation of the lenses the refraction is usually found to be very highly myopic because of the second of these factors.

LESLIE L. MCCOY, M.D.

EAR

Asherson, N.: Convulsions and Post-Convulsive Paralysis of Otogenic Origin; Some Clinical Observations and Case Records. *J. Laryngol. & Otol.*, 1940, 55: 303.

A convulsion frequently draws attention, for the first time, to the presence of a serious and, up to then, unsuspected intracranial complication in a patient with a well developed aural suppuration, whether acute or chronic. On the other hand, in young children only, a convulsion may be the first clinical manifestation of the presence of an acute otitis media and, as such, has only a transient diagnostic significance. Focal, unilateral, jacksonian, or generalized convulsions associated with established aural suppuration are always due to cortical irritation, whether from outside the cortex or from a cortical thrombophlebitis, or from extension toward the cortex of an intracerebral (such as a temporal lobe) abscess. Convulsions develop under a number of conditions in association with suppurative ear conditions. The convulsions may be generalized or jacksonian (focal).

At the onset of an otitis media in infants, when the condition is due to what is termed meningismus, the convulsion is due to the ear condition alone, as a reflex irritative cerebral phenomenon, and not to an actual inflammatory cerebral cortical involvement. It might be accounted for by an acute otitic hydrocephalus. This could be diagnosed and confirmed clinically only by performing a lumbar puncture and recording the pressure of the cerebrospinal fluid. Tuberculous meningitis is a common cause of convulsions in infants and young children. Convulsions are not uncommon in children, but are rare in adults. The convulsion may arise from: (1) encephalitis, otogenic, non-suppurative (rare); (2) an extradural abscess; (3) subdural abscess; (4) abscess of the temporal lobe, with extension to the cortex; (5) otitic hydrocephalus; and (6) otogenic meningitis. If the patient has an acute otitis of recent origin, the question as to whether the convulsion is due to any of these causes other than meningitis (6) does not arise. It can then be due to only: (a) otogenic meningismus, in infants or young children; (b) otogenic meningitis; (c) extra-aural causes, e. g. pneumonia in infants and young children; or (d) possibly an encephalitis (this cannot be diagnosed at this stage), or tuberculous meningitis. At a later stage of the acute otitis, e. g., after the first fourteen days, any of the causes from 1 to 6 may operate.

The following factors are guides to treatment in the presence of a convulsion of otogenic origin. With the onset of a convulsion:

1. In the presence of an acute earache, the ears should be examined, and a myringotomy performed, the pus being sent for culture to ascertain the organism. If there is any suspicion of nuchal rigidity, a lumbar puncture is forthwith indicated.

2. Lumbar puncture is also indicated if the convulsions recur, or the patient fails to respond rapidly to the myringotomy.

3. When the acute otitis media is well established a lumbar puncture is immediately performed, with measurement of the fluid pressure, and cytological, chemical, and bacteriological examination of the fluid. A complete neurological examination is made, followed by a mastoid operation with exposure of the dura of the temporal lobe. The dura and temporal lobe should be explored by brain puncture, after the extended mastoid operation has excluded the presence of an extradural abscess in the middle cranial fossa. The lateral sinus should also be explored by puncture. The radical mastoid operation is not required, as a rule.

4. In the presence of a chronic ear discharge an immediate radical mastoid operation is undertaken with extensive exposure as in Paragraph 3, after the lumbar puncture and neurological examination.

NOAH D. FABRICANT, M.D.

PHARYNX

Trout, H. H.: Ludwig's Angina. *Arch. Surg.*, 1940, 41: 532.

The author gives a rather complete description of the history of Ludwig's angina and especially of the connection of Ludwig's name to the disease. He suggests that the difference in the definition of the disease accounts for the tremendous diversity of the results. The mortality quoted from most authors varied between 5 and 75 per cent. He believes that among the cases of Ludwig's angina only those should be included in which the patient is desperately ill, sometimes fighting so hard for breath that emergency tracheotomy is indicated even before any attempt is made to release the tension in the neck.

In a review of the reported cases he finds that the etiological factor is the extraction of the lower molar or posterior bicuspid teeth in 82 per cent of the cases. He finds that the bacteriology of the disease corresponds to the organisms which are found in the tooth pockets both before and after extraction of the teeth. The author therefore recommends that if the gums or teeth to be extracted are badly involved in an infection, it may be a wise precaution to develop in the patient a concentration of sulfanilamide in the blood adequate to prevent further spread of the infection. He believes that this drug has a distinct place in the field of prophylaxis in the extraction of teeth in infected fields. Sulfanilamide may also be employed as a fine powder placed in the tooth pocket after the extraction. If anaerobic bacteria are asso-

ciated the use of zinc peroxide has been found to be valuable. Anatomically, he has found that the mylohyoid muscle is of great significance in producing the respiratory difficulty. It raises the hyoid bone and thus obstructs respiration.

The author believes that if, after the extraction of a lower molar tooth, a hard swelling occurs under the tongue, it is the duty of the dentist to call into consultation the surgeon who may have to open up the neck widely and hurriedly in order to save the patient's life. If the patient's condition is not so desperate as to demand an immediate tracheotomy one of the intravenous anesthetics, preferably sodium pentothal, can be employed, but even then the tracheotomy set should be handy, as these patients sometimes have embarrassment of respiration after the administration of an intravenous anesthetic. Oxygen, carbon dioxide, and coramine should be handy. The employment of helium in association with either nitrogen monoxide or ethylene, has not yet reached the stage of practical application. Certainly if tension is to be relieved in these cases more than simple incision and drainage will have to be done, for as a rule very little pus will be found. The necrotic and gangrenous material should be removed. Some authors advocate the routine removal of the submaxillary gland, but this should not be done unless the gland is involved in the inflammatory process or is interfering with drainage. Care should be exerted to prevent the dissection from extending through the mucous membrane into the mouth. The incision should start at the angle of the jaw about ½ in. from the border and continue to the chin. If the infection is bilateral this incision should continue in the same manner on the opposite side. It should continue through the deep cervical fascia to the muscles of the mylohyoid muscle. When the fibers of this muscle are reached they should be cut transversely. The anterior belly of the digastric muscle should also be cut transversely. By the cutting of these muscles in this manner the pull on the hyoid bone is released, which is not the case with any incision which enters the deep structures by merely separating the fibers of the mylohyoid muscle. The respiratory relief in these cases occurs almost immediately and before the incision extends to the involved tissues beneath the tongue. It is a life-saving procedure and thus no consideration should be given to the possible appearance of the scar after the patient's recovery. The incision is packed with gauze and left wide open so as to allow free and full drainage. Plastic operation can be done later to improve the appearance of the scar.

WILLIAM C. BECK, M.D.

Richards, L. G.: The Treatment of Diseases of the Throat. *J. Am. M. Ass.*, 1940, 115: 501.

The term "throat" is divisible into the mesopharynx and the hypopharynx. The chief organ within the latter is the larynx. Within the mesopharynx lie masses of lymphoid tissue which constitute Waldeyer's ring. The treatment applied to the faucial tonsils may be taken as representative of the treatment essential for other small areas of lymphoid tissue with similar involvement. Thus, acute follicular tonsillitis is representative of the commonest form of acute lymphoid infection. Its treatment consists of two parts, systemic and local measures which are well known.

In peritonsillar abscess or quinsy sore throat, there is a localized collection of pus in the supratonsillar space. During the preliminary period in which an abscess may be forming, incision and drainage are contraindicated. The ideal therapy consists in relief of pain by sedation and by hot saline irrigations within the throat. Once existence of a peritonsillar abscess has been established by the clinical signs such as trismus, a point of maximum induration or suggestive fluctuation above the point of juncture of the anterior and posterior pillars, surgical drainage is indicated. It is advisable to institute drainage under local cocaine anesthesia. A long-handled knife is carried directly posterior at a point just above and median to the superior pole of the tonsils and directly through the soft palate tissue. The knife is carried inward for a distance of from 1 to 1.5 cm. and then withdrawn. If an abscess is present, there will shortly follow a thin trickle of yellow pus. A hemostat is next introduced and quickly and vigorously opened to permit a further gush of pus. Thereafter, hot saline irrigations for one or two days will lead to prompt relief. Subsequent tonsillectomy, at a future date, is advisable.

The treatment of acute retropharyngeal abscess is essentially surgical. Richards prefers drainage with the patient in the supine position, the head extended over the end of the table, and the operator sitting at the patient's head, facing his feet. With the anterior wall of the abscess exposed by direct illumination, a long-handled knife can be passed into the abscess cavity. Pus is manifested by a trickle of yellow fluid from the point of incision. In much the same manner as in the case of peritonsillar abscess, a hemostat is used to divulge the edges of the wound.

It is important to bear in mind the rare but possible secondary hemorrhage. Once such a hemorrhage has occurred with temporary cessation it is the part of wisdom to proceed at once with ligation of at least the common carotid artery and possibly also of the external carotid artery. Neglect of a warning primary hemorrhage is fraught with the greatest risk to the patient's life.

The lodgment of a foreign body in the mesopharynx, either at the pharyngeal end of the esophagus in one or the other of the pyriform sinuses, or between the epiglottis and the base of the tongue, is a clear indication for its removal. When it consists of a sliver of chicken bone or fish bone, it can easily be removed indirectly by means of a curved grasping forceps. If the foreign body is impacted or likely to result in laryngeal trauma, preparations should be made for proper endoscopic removal under direct vision. Foreign bodies in the pharyngeal end

of the esophagus are usually not visible on direct inspection. Much will depend on the history given by the patient. Removal is indicated, usually by the direct esophagoscopic method.

NOAH D. FABRICANT, M.D.

De Moro Guevara, C. J.: Remarks on 30 Cases of Amygdaloid Cyst Treated Surgically (Comentarios sobre treinta casos de quistes amigdaloides tratados quirúrgicamente). *Semana méd.*, 1940, 47: 79.

The author deplores the fact that amygdaloid cyst is the object of erroneous diagnosis and treatment in many patients for months and even years, when simple puncture and microscopic examination of the obtained fluid could easily settle the question. A drop of the fluid is spread on a slide and stained as if it were a drop of blood; it will show masses of large epithelial cells having a diameter of from 40 to 50 microns and a large protoplasm which is slightly basophil, at times hyaline and at other times finely granular or completely vacuolar. The contour of the protoplasm is polygonal when the cells are close together and round when they are isolated. The nucleus is small, central, and has a compact or a finely granular chromatin.

Amygdaloid cyst, which is also called branchioma, branchiogenic cyst, and pharyngoid cyst of Chevassu, is frequently diagnosed as tuberculous adenitis, studied and treated as such, but naturally without results. In the 30 cases treated by the author, the age of the patients varied from fourteen to forty-six years in the males and from ten to thirty-eight years in the females. One of the patients had bilateral fibrocaseous pulmonary lesions and pleurisy; nevertheless, his cervical process was distinctly nontuberculous and the condition was proved to be an amygdaloid cyst. In 25 of the 30 cases, the cyst was located under the anterior border of the sternocleidomastoid muscle (upper carotid region) and in 1 case it presented a posterior localization. The process develops insidiously without the slightest interference with the general condition of the patient, without febrile reaction, and without involvement of the skin: therefore, the patient usually comes under observation when the cyst has already acquired a considerable size. However, at times the cyst develops rapidly and the accumulation of fluid under pressure inside of the cavity causes pain. Its relation to the ganglions of the carotid region may give rise to reactions of inflammatory type, which may produce the impression that the swelling is going to open spontaneously. In these cases, the intervention must be delayed until the inflammatory signs have subsided, even when the diagnosis has been established by puncture. It is well known that lymphoid tissue is very sensitive to roentgen rays; therefore, three or four irradiations are given and the intervention can then be performed in noninflamed tissues.

Extirpation of the cyst is simple; the author has used the technique of A. J. Pavlovsky, who approaches the cyst through a transverse incision of the skin and a vertical incision of the fascia. He has never found it necessary to cut the sternocleidomastoid muscle or to sacrifice any important cervical elements. Evidently, the technique must be adjusted to suit the individual case. Lately, the author has adopted the habit of making a small counteropening 1 cm. below the incision, which is completely closed at the end of the operation; the opening serves to accommodate a small rubber drainage tube which is removed on the fourth day. The reason for using the drain is that always, or nearly always, some blood or serosity accumulates in the wound in spite of the most careful ligation of the small vessels; in 1 case, the amount of fluid present made it necessary to reopen part of the incision. Six cases are described. RICHARD KEMEL, M.D.

NECK

Davis, A. C., and Howell, L. P.: Medical Management of Diseases of the Thyroid Gland. *Med. Clin. North Am.*, 1940, 24: 991.

Except in diffuse colloid goiter and the hypothyroid states, the treatment of thyroid disease usually requires the consideration of surgical intervention. The latter is the procedure of choice in all cases of hyperthyroidism and in selected cases of adenomatous goiter without hyperthyroidism, carcinoma of the thyroid gland, and thyroiditis.

Diffuse colloid goiters of any appreciable size occur rarely after the second or third decade of life. They are most common in adults during pregnancy. They are mainly, if not entirely, the result of the morphological response of the thyroid gland to an inadequate supply of iodine. The gland usually responds to the use of iodine by diminishing in size. If adenomatous goiters without hyperthyroidism contain relatively large amounts of colloid, some diminution in size may follow the ingestion of iodine but the adenomas remain. Iodine does no good in these cases and therefore it should not be used. There is no curative medical treatment.

We give iodine in the form of Lugol's solution, 10 drops three times a day for several days, in the preoperative treatment of adenomatous goiter with hyperthyroidism, for two reasons. First, the routine use of iodine will protect the patient against unsuspected exophthalmic goiter and all of its attendant dangers. Secondly, in some of these cases, it seems to exert a beneficial effect on the disease.

Auricular fibrillation is the most common arrhythmia associated with hyperthyroidism. Unless congestive heart failure is present, the auricular fibrillation rarely requires special pre-operative treatment. Auricular fibrillation alone should never be a contraindication for thyroidectomy.

Auricular flutter is encountered infrequently. If this arrhythmia persists after several days of rest and iodinization, the use of quinidine to stop the flutter is to be considered before proceeding with thyroidectomy. If it is considered unwise to give

quinidine or if the flutter persists despite real effort to convert the rhythm by using digitalis and quinidine or quinidine alone and if there is no evidence of congestive heart failure, it becomes necessary to proceed with thyroidectomy.

We believe that the association of angina pectoris with goiter is usually an indication for thyroidectomy. Our experience with total thyroidectomy for coronary disease has not been encouraging. Except possibly for the use of digitalis, the pre-operative treatment for congestive heart failure associated with hyperthyroidism is the same as for any case of primary heart failure.

True diabetes is not a rare complication of hyperthyroidism. The appearance of hyperthyroidism invariably aggravates the severity of the diabetes and recovery from the hyperthyroidism is accompanied by improvement in the severity of the diabetes.

The treatment of hyperthyroidism complicated by moderate or severe diabetes mellitus raises problems that do not arise during the management of either disease alone, because of the fact that each disease intensifies the ill effects of the other. In as much as the modern treatment of diabetes is much more flexible so far as details are concerned, as compared to the treatment of hyperthyroidism, it is advisable to modify the standard treatment of diabetes to meet the peculiar needs of the patient with hyperthyroidism. The diet, therefore, should be extremely liberal in its total caloric and carbohydrate content.

Sufficient insulin should be given to keep the urine approximately sugar-free.

Pregnancy does not contraindicate thyroidectomy for adenomatous goiter with hyperthyroidism. The fear of causing the patient to abort should not deter the surgeon, as spontaneous miscarriages are prone to occur when hyperthyroidism is uncontrolled.

We believe that at present sulfapyridine is the treatment of choice for pneumonia occurring after thyroidectomy. Oxygen may be desirable as a supplement, its use depending on the extent of the pneumonia and the degree of toxemia and cyanosis.

Auricular fibrillation that appears postoperatively usually disappears spontaneously. This may also be true in the case of auricular flutter, which is less common than auricular fibrillation under such circumstances.

Respiratory obstruction with anoxemia is not an unusual complication and may arise from several causes: injury to the recurrent laryngeal nerves with paralysis of one or both vocal cords, edema of the larynx or of surrounding structures, tetany with laryngospasm, postoperative hemorrhage, and occasionally tracheal collapse. The last two complications are primarily surgical.

Thyroidectomy is usually the procedure of choice for exophthalmic goiter. In general, the management of complications such as heart disease, pneumonia, diabetes, pregnancy, and respiratory obstruction is the same in cases of exophthalmic goiter as in those of adenomatous goiter with hyperthyroidism.

The beneficial effect of iodine on the course of hyperthyroidism has been noted repeatedly.

The improvement following the use of iodine in exophthalmic goiter is manifested in two ways: (1) by lowering the basal metabolic rate and (2) by amelioration of those symptoms that are peculiar to exophthalmic goiter, particularly the tendency toward crisis.

The value of rest in the treatment of exophthalmic goiter can hardly be overemphasized and this applies to freedom from mental cares and responsibilities as much as it does to physical relaxation.

The treatment of the hyperthyroid crisis depends on its immediate recognition and on the early and continuous administration of iodine.

Before a patient who has exophthalmic goiter may be said to be in ideal condition for thyroidectomy, the following conditions should be fulfilled: (1) the absence of any recent history of serious myocardial insufficiency, gastro-intestinal crisis, or respiratory infection; (2) a good intake of food and an increasing weight; (3) freedom from severe nervous irritability or stimulation; (4) ability to sleep normally; (5) absence of jaundice or other evidence of hepatic damage; (6) absence of evidence of myocardial insufficiency, such as edema, moisture in bases of the lungs, coronary pain, or dyspnea; (7) good muscular strength as evidenced by the patient's ability to take a step approximately 15 inches (37.5 cm.) high without assisting himself by using the upper extremities; (8) recent definite decline in the basal metabolic rate; (9) continuous administration of liquor iodi compositus in doses of 10 drops three times daily over a period of from seven to fourteen days; and (10) the patient should be up and around for from four to six hours daily without undue fatigue for four or five days preceding the operation.

A given patient may not fulfil all of the conditions and it may be necessary to proceed with thyroidectomy anyway. The risk of the operation, however, will be increased definitely. Hence, operation should be delayed until there is no reasonable chance of further improvement being obtained with medical management.

Myxedema appears as a sequela of thyroidectomy or results from thyroiditis. Regardless of the etiology or the level of the basal metabolic rate, the authors use desiccated thyroid gland in practically all of their cases. At the outset they make certain that cardiovascular disease, nephritis, or other metabolic disease is not present. If these diseases are present, the use of desiccated thyroid gland is undertaken with rigid precautions and safeguards. We rely chiefly on the basal metabolic rate as an effective gauge of treatment. Determinations of the blood cholesterol are helpful.

The successful treatment of cretinism depends in part on making the diagnosis and on starting the treatment early enough. The successful management of endemic cretinism is largely prophylactic, that is, the pregnant mother who is hypothyroid should be treated.

The medical management of carcinoma of the thyroid is limited to diagnosis. The treatment is primarily a surgical problem.

For the non-suppurative type of acute thyroiditis, the treatment is symptomatic. The compound solution of iodine is administered, however, as some degree of hyperthyroidism is usually present. The application of heat would seem likely to encourage resolution but the patient is usually more comfortable with an ice collar. When suppuration can be demonstrated, prompt drainage is indicated. This is usually followed by rapid relief of the symptoms, and healing is usually rapid and complete. There is little danger that thyroid insufficiency will develop following acute thyroiditis.

Howie, T. O.: Tuberculosis of the Larynx in Childhood. *J. Laryngol. & Otol.*, 1940, 55: 269.

Tuberculosis of the larynx may be present in a child without giving any signs or symptoms. It is only by systematic routine examination that a definite diagnosis can be made.

This report deals with a group of 159 children between the ages of four months and sixteen years. These patients had been under treatment for periods varying from six months to seven years. Of these 159 patients, 90 revealed the presence of tubercle bacilli in the sputum or after stomach lavage. Thirty-eight of these patients showed tuberculous laryngeal lesions. Only 3 of the last did not reveal bacilli in the sputum or after lavage.

The first thing that stands out is the almost constant appearance of "open" tuberculosis in the cases showing laryngeal involvement; the frequency was 38 of 41 cases. Bovine and human infection seem equally prone to produce laryngeal disease. Most of the disease occurs in cases showing cavitation and bronchopneumonic lesions in the lungs.

Signs and symptoms in the early stages of the disease are seldom present. The child makes no complaint of discomfort or pain and it usually is not hoarse. No patient suffers from dysphagia.

The lesions found varied in types. Some of them consisted of a slight streaking of one cord and others of extensive destruction of the larynx with perichondritis and fetid breath. The most common site of the lesion was in the posterior part of the larynx and the interarytenoid area and on the posterior extremity of the cord. The disease usually began with a peaking of the interarytenoid area. This was followed by destruction of one or both cords and a few of the lesions progressed to a tubercular papillomatosis. In 2 patients this outgrowth sloughed off and left an extensive area of destruction. One case showed a typical turban epiglottis.

Treatment has been found difficult because it is not possible to enforce absolute silence upon children. One has to be content with whispering. In all cases an inhalant of creosote was used. No local application, ultra-violet irradiation, nor electric cautery was used in these children.

J. Daniel Willems, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Rynearson, E. H., and Kepler, E. J.: Diseases of the Pituitary Gland. *Med. Clin. North Am.*, 1940, 24: 953.

Morphologically and physiologically, the pituitary body should be regarded as at least two distinct units, the anterior lobe and the posterior lobe.

The known types of cells in the anterior lobe of the pituitary which are normally present are the acidophil (sometimes referred to as the eosinophil), whose cytoplasmic granules stain brilliantly with acid or plasma dyes; the basophil, whose cytoplasmic granules are less distinct and more irregular in size and form than those of the acidophil and take the basic dyes; and the chromophobe, whose cytoplasm is devoid of specific granulation. In addition to these three types of cells, two others have been associated with special conditions: (1) the "signet ring" or castration cell which is found in the anterior lobes of castrated animals of certain species and is a modified basophil, and (2) the "pregnancy cell" found during and after pregnancy, which was originally described in the human being as a modified acidophilic type.

We have no idea how many hormones are secreted by the anterior lobe of the pituitary gland. We would be far safer if we were to speak of principles having differing effects rather than of different hormones, for it is improbable that one gland composed of only two known types of secreting cells can produce all of the separate hormones which are credited to it. Specific fractions having hormonal properties have been prepared from extracts of the anterior lobe.

1. The growth principle. There is considerable controversy as to whether there is a specific growth hormone.

2. The thyrotropic principle. This fraction restores to normal the cells of the thyroid gland which have atrophied as a result of hypophysectomy or it will cause hyperplasia of normally flattened epithelium in certain animals such as the guinea pig. When injected into human beings or animals, it causes an increase in the basal metabolic rate if a functioning thyroid gland is present.

3. The gonadotropic principle. At present there are believed to be two of these substances: (1) follicle-stimulating, which stimulates the follicles in the ovary and the germinal epithelium in the male, and (2) luteinizing, which stimulates the development of the lutein cells in the ovary and the interstitial cells and accessory sex glands of the male. Other gonadotropic fractions have been described but have not been accepted generally. As a matter of fact, some authors have stated that there is only one gonadotropic hormone which has different quantitative effects.

4. The adrenocorticotropic principle. This substance repairs the atrophy that occurs in the adrenal glands of hypophysectomized animals.

5. The mammatropic or lactogenic principle. When this is injected into animals, it causes development and lactation of the breasts. This is the only hormone which has been isolated in crystalline form.

6. The diabetogenic principle. This substance has a distinct effect on the carbohydrate metabolism.

7. A ketogenic principle. This substance induces the development of ketone bodies. The existence of such a hormone is in considerable doubt.

8. A parathyrotropic principle. Its existence also is in doubt.

9. Separate principles have been described having effects on the metabolism of carbohydrate, protein, fat, and water.

10. A specific metabolic principle has been described.

11. A hematopoietic "hormone" has been suggested.

The usual pathological processes which can involve any other glands of internal secretion are also found in the pituitary gland. These have been listed by Rasmussen as (1) destructive lesions, (2) adenomas, (3) other tumors, (4) animal parasites, and (5) craniopharyngiomas and suprasellar cysts, which by their location cause a destruction of the pituitary gland and secondary interference with function of the gland. The two types of pathological processes which deserve special mention are the first two. If destructive lesions occur in early life, dwarfism or infantilism in one form or another usually results. Extensive necrosis or atrophy of the anterior lobe in later life may be followed by hypophyseal cachexia or Simmonds' disease.

Patients suffering from infantile dwarfism have been treated with all of the means at the authors' disposal. Theoretically, the growth hormone of the anterior pituitary lobe should restore them to normal size. Actually, we have found no such case in the medical literature in which the evidence presented could be considered as conclusive.

A male patient with Froehlich's syndrome is unnaturally obese; the deposits of fat resemble those of the female, and produce large hips, breasts, and mons veneris. The genital organs, both internal and external, remain underdeveloped; the testes may remain undescended. Secondary sexual characteristics do not develop. In the female, obesity is marked and amenorrhea is the rule. In neither sex is there sexual feeling or activity. In both sexes the skin is soft, pale, fine, and hairless except for the scalp, where the hair is fine and silky. The epiphyses sometimes remain ununited and other skeletal changes are noted, as illustrated by the hands, which are small and fat, and have tapering fingers.

Too many patients are being given the diagnosis of Froehlich's syndrome. It is really a rather rare

condition and every fat boy with delayed development does not have a craniopharyngioma which is destroying his pituitary gland. If let alone, most of these fat boys "straighten out" themselves and most of the "cures" reported following the use of endocrine preparations probably would have occurred if no treatment had been given.

We wish to emphasize that (1) Simmonds' disease is an entity, (2) it is extremely rare, (3) many of the patients reported to be suffering from Simmonds' disease really have anorexia nervosa, and (4) therapeutic response is a poor basis for diagnosis.

There is no evidence to indicate that gigantism and acromegaly are essentially different. Both are caused by the excessive production of the growth hormone from a tumor or hyperplasia of the eosinophilic cells. If this condition develops before the ossification centers are complete, then gigantism is produced. If the excessive output of the hormone occurs after the ossification centers are complete, the resultant deformity is called acromegaly. This condition is characterized by overgrowth of the short and long bones, enlargement of the viscera, changes in the muscles, and hypertrophy of the skin and connective tissues.

Both acromegaly and gigantism may burn out spontaneously, possibly as the result of cystic degeneration of the tumor. Even patients with progressive disease may go on satisfactorily for many years. Death may be produced by intercurrent infection, the final cachexia of the disease, congestive heart failure with or without hyperthyroidism, or the pressure effect of a large tumor. Formerly, diabetic coma accounted for a fair percentage of the deaths.

Treatment of gigantism or acromegaly is unsatisfactory. The surgical removal of the responsible tumor is advised only when detailed examination of the visual fields gives evidence that blindness is likely to ensue. Numerous reports regarding roentgen treatment have been published, some of which give an account of careful studies and encouraging results.

The clinical syndrome known as pituitary basophilism, or Cushing's syndrome, may be associated with a hyperfunctioning adenoma composed of basophilic cells. The syndrome is not a specific one limited to basophilic adenoma of the pituitary gland.

The diagnosis of Cushing's disease is always fraught with uncertainties, and it should never be made until the other diseases which may be associated with Cushing's syndrome have been excluded. In doubtful cases the adrenal glands and pelvic organs should be explored surgically, and efforts made to exclude thymic neoplasms.

Treatment is not very satisfactory. Roentgen therapy has been used with considerable success in isolated instances.

Although the function of the posterior lobe is not known definitely, experimental and clinical evidence suggests that it probably (1) controls the flow of urine and thereby regulates water balance, (2) influences the carbohydrate metabolism, and (3) has something to do with the onset of parturition.

Not every patient who drinks large quantities of water and voids excessive amounts of urine has diabetes insipidus. For many individuals this is a manifestation of nervousness. The differential diagnosis can be made by testing the ability of the kidney to concentrate urine.

Treatment for diabetes insipidus obviously consists of replacing the hormone which by its lack causes the disease.

NON-TUBERCULOUS THORACIC EMPYEMA

A Collective Review of the Literature from 1934 to 1939

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ACUTE thoracic empyema has for many years been the pre-occupation of many surgeons and in the past five years much has been written about it. Admirable historical surveys of the preceding years have been offered by Carlson, Bettman, Graham, and others. My own efforts do not embrace the progress that has been made since Hippocrates suggested open drainage and probably supported his operation by quotations from the writings or utterances of his predecessors. The Empyema Commission soon after 1918 established most of the rules for proper treatment, and their precepts have been almost as universally accepted as the rules of syntax.

It is perhaps a pity that the compilation of statistics does not provide an exact answer as to what method of treatment is most suitable for the physician to use in his efforts to cure a particular patient. Allen and others have concluded that each case must be considered separately. However, from what has been written certain conclusions can be drawn. Chief among these is a reaffirmation of the value of the principles set forth by the Empyema Commission. Setting aside the minutiæ of treatment these principles remain.

Among the details that surround the principles is the problem of what this disease shall be called. Suppurative pleurisy and purulent pleuritis have been offered as more exactly describing the pathological process that takes place; doubtless these terms are more accurately descriptive. Empyema thoracis, thoracic empyema, and pleural empyema are advocated as more accurately defining the location of the pus; and this, too, is true. However, for the purposes of simplicity and for the avoidance of awkward construction, I prefer the word "empyema" defined only as "acute" or "chronic" when that modification is necessary. Tuberculous empyema is a distinct entity with diagnostic and therapeutic problems quite different from those that attend non-tuberculous pleural infection.

INCIDENCE

It is difficult to determine accurately how many cases of empyema occur. It is not a reportable disease nor is it listed as a cause of death. White has reported a series of 317 cases from all the hospitals of Washington, D. C., in a report which covered five years. Since the population of Washington is more than half a million, the rate of occurrence is not very high. However, in 14 of these cases the diagnosis was not made before death, even though the patients were in hospitals, so it is obvious that a fair number of patients died of empyema without even being admitted to a hospital for diagnosis and treatment. Gezelius reported 159 cases in 15,302 admissions to the Children's Hospital in Gothenburg, an incidence of slightly more than 1 per cent. One conclusion to be drawn from these figures is that the average physician will see relatively few cases during his lifetime and that only a few specialists will see many cases.

ETIOLOGY

Empyema is rarely, if ever, a primary disease. It is most frequently secondary to pneumonia or influenza. However, there are other causes. Pulmonary abscess frequently causes a distressing type of empyema. Neuhof and Hirshfeld found that putrid empyema due to the perforation of a pulmonary abscess occurred in 17 of 184 children with empyema and in 25 of 100 consecutive cases of abscess of the lung. Among 55 cases of pulmonary spirochetosis studied by Kline and Berger empyema occurred in 26. Michalowicz found 38 cases of putrid empyema among 1,450 cases of empyema in children. Penetrating wounds of the chest, when occurring in civil life, are only seldom the cause of empyema. Steinke found that it occurred in only 3 of 87 such wounds. Bronchiectasis may occasionally cause empyema by the perforation of a bronchiectatic abscess into the pleural space. This danger is considerably augmented by the use of pneumothorax in the treatment of bronchiectasis.

Steinberg, Clark, and De la Chapelle have called attention to 4 cases of empyema which followed sterile pulmonary emboli and thrombosis; they believe that secondary infection of the pulmonary infarct through a bronchus produced suppurative pneumonitis and empyema. Wolfe had a case of empyema which was caused by the metastasis to the lung of a malignant thyroid

adenoma. Empyema may also be caused by primary pulmonary tumors which have obstructed a bronchus. Prolonged bronchial occlusion is invariably followed by suppuration in the portion of lung drained by that bronchus and perforation into the pleural space may then occur. The perforation of a subdiaphragmatic abscess or a perirenal infection into the pleural space is another cause of empyema (Harrington, Zwirn). Lane's interesting case, in which the bacillus typhosus was found in the pus, occurred forty years after an acute attack of enteric fever and was thought by him to be secondary to typhoidal osteitis of a rib.

Intrathoracic operations may be a cause of empyema. The introduction of a needle into the pleural space for the aspiration of sterile fluid, in the course of pneumothorax treatment, or to obtain an aspiration biopsy, may result in empyema either by the implantation of organisms from the exterior or by injury to the lung. Infection of the pleura may also occur subsequent to perforation of the esophagus. Septicemia is very rarely a direct precursor of empyema.

Nevertheless, pneumonia and influenza are preponderantly the cause of empyema and this is true particularly in children. Burpee found that 80 per cent of his cases were caused by pneumonia and 7 per cent by influenza. This ratio would doubtless change if another epidemic such as that of 1918 should occur. Empyema occurred secondary to pneumonia in 94 of Lloyd's 104 cases, 96 of Mason's 103 cases, 335 of Steinke's 459 cases, and 189 of Tanner's series of 207 cases. In Michalowicz' series of 1,450 collected cases of empyema in children, pneumonia was indicted as the cause in 63 per cent and in a further 20 per cent the empyema followed infectious diseases or exanthemas; in many of the latter cases it is reasonable to suppose that pneumonia was the direct intervening cause.

On the other hand, only about one-tenth of the patients with pneumonia develop empyema; Ashby says between 10 and 12 per cent. Hurwitz and Stephens found that empyema occurred in 9 per cent of 629 cases of pneumonia in children under twelve years of age. Maes, Veal, and McFetridge reported that during a ten-year period there were 6,056 cases of pneumonia in the Charity Hospital and in 11.2 per cent of these empyema developed; they believe that the incidence after influenza is slightly less unless the influenza is epidemic. Penberthy and Benson had 407 cases of empyema among 5,868 cases of pneumonia in the Children's Hospital in Detroit, an incidence of 7 per cent.

It is to be expected that the more widespread use of sulfapyridine and sulfanilamide will cause a considerable reduction in the number of patients with pneumonia who develop empyema. Schwartz, Flippin, and Turnbull studied 351 patients with pneumococcic pneumonia and found that of the group that was treated with type-specific serum 10 per cent developed empyema, whereas of those who were given sulfapyridine only 2.3 per cent subsequently had empyema. Thompson, Edwards, and Hoagland have reported 121 cases of pneumonia treated with specific antiserum; 12 of the patients developed empyema. Of 142 patients treated with sulfapyridine only 4 had empyema. Doubtless many others who use sulfapyridine in treating pneumonia will have similar experiences.

Since about 80 per cent of empyema is caused by pneumonia, it is reasonable to suppose that the pneumococcus, streptococcus, and staphylococcus are the organisms most frequently found in empyema. In about a score of papers the causative organism has been determined in a sufficiently large number of cases to be significant. Bacteriological examination of the pus was carried out in about 3,000 cases collected from the literature of the last five years and the pneumococcus was found in 63.9 per cent, the streptococcus in 9.4 per cent, and the staphylococcus in 6.5 per cent. Combinations of pneumococcus, staphylococcus, and streptococcus were much less frequently found; and the influenza bacillus was only very occasionally the mischief-maker. Chatterjee reported 1 of 22 cases to be due to the bacillus influenzæ, Harloe 1 of 351 cases, and Wallace 1 of 363 cases.

Other organisms are found so rarely as to be curiosities and are reported as such. Bisgard reported 2 cases of actinomycotic empyema; the patients have remained well sixteen and twenty-six months after several operations. Brunner had 3 patients with empyema due to the fundiliform bacillus; each recovered after drainage and the administration of neosalvarsan. He believes that the prognosis in such cases is good because of the tendency toward early encapsulation. Lane and Francis treated a patient with empyema due to the typhoid bacillus and Harloe had 1 in his series of 351 cases. Carnazzo reported 2 cases due to the colon bacillus in his group of 22, and Mason found that 2 in a series of 103 were due to this organism. Grevillius and Quarnå have recorded the case of a child of eighteen months with empyema due to the bacillus megatherium; the child recovered completely after rib resection for drainage.

The fact that these organisms may cause empyema is of importance because of the diagnostic hurdles such bizarre bugs may place before one.

MacDonald had a patient with empyema in whom drainage was long delayed because the pus was at first sterile on routine cultures. Quite proper reasoning led him to delay drainage because the failure to demonstrate a pyogenic organism occasioned the belief that the infection was due to the tubercle bacillus. Subsequently a pure culture of bruc lla abortus was grown from the pus; after drainage the patient's recovery was complete.

Most curious is the case reported by Zwirn, Joyeux, and Aboucaya; their patient was a thirteen-year-old girl who developed empyema subsequent to an appendicectomy. When the chest was opened for drainage an adult male worm, identified as ascaris lumbricoides, was found in the pus. The worm was dead and had ingested a large amount of pus Subsequently the patient developed pericarditis and pulmonary edema and the bacillus coli was found on blood culture. Examination of the stools revealed eggs of the ascaris and the trichocephalus. Vermifuges were given and the child recovered after a prolonged illness. The authors have found 10 similar cases in the literature. It is not clear how the worm entered the pleural cavity but its presence there may have been the result of direct perforation of the intestine through the diaphragm or through the liver, or, most likely, of aspiration of the worm from the pharynx into the lung and subsequent perforation of the pleura.

DIAGNOSIS

The diagnosis of empyema is largely the result of the suspicion that there is pus in the pleural cavity, and the proof of its presence with the actual removal of some of it as the definitive step. It is by now well known that pneumococcus empyema usually occurs some time after the pneumonia has subsided (metapneumonic), whereas the streptococcus type of empyema is usually concurrent with pneumonia (synpneumonic). Differences in treatment are dependent upon these facts.

Bettman succinctly states that the diagnosis depends upon septic temperature, flatness on percussion, roentgenographic signs, and the aspiration of pus from the chest. Harloe suggests that protracted or so-called unresolved pneumonia generally means empyema. Sometimes, rarely to be sure, even all these factors may be misleading. Shaw reported the cases of 3 patients with acute diffuse bronchiectatic abscesses superimposed upon obstructive emphysema; in each of these the clinical course, physical examination, roentgenograms, and the aspiration of small amounts of pus led to an erroneous diagnosis of empyema. In 2 of the patients thoracotomy was performed and at operation it was found that the pus was intrapulmonary rather than intrapleural. Shaw believes that the paucity of the amount of pus that can be aspirated and its thick mucoid character should arouse suspicion that the pus comes from within the lung. In such circumstances a futile thoracotomy may occasionally be done. It is preferable, I believe, occasionally to perform an unnecessary but harmless operation than to neglect to do an essential one.

It is important that the diagnosis of empyema should be made early, since treatment, consisting of the complete and rapid evacuation of pus, should begin early in order to save the patient from the distressing physical and systemic effects of untreated infection and in order that the postoperative course will not be unnecessarily prolonged. Fitzgerald has emphasized that delay in operating in acute empyema is dangerous if the functional value of the lung is to be maintained. Horine and Baker carefully studied 103 cases of empyema in children less than thirteen years of age in order to determine the influence of "the duration of illness prior to treatment as a factor in empyema complications as well as a factor to be considered in the reduction of mortality rates irrespective of the type of operation." In this group there were 16 deaths and 12 of these occurred in children who had been ill more than three weeks. Of those patients who recovered, 70 had been ill three weeks or less, while only 7 had been ill more than three weeks before receiving treatment. Furthermore, one or more serious complications occurred in all of the fatal cases. Hurwitz and Stephens believe that "diagnosis and treatment of empyema are still far from satisfactory." In one of their illustrative cases the diagnosis was not made for several months in spite of the continuation of symptoms following pneumonia, and, in another, open drainage was carried out during the active stage of pneumonia and the drainage tube was allowed to remain in place for more than three months without being changed or cleaned. In an analysis of 100 fatal cases of empyema, Maes, Veal, and McFetridge found that 40 patients died of toxemia and exhaustion and in all of these empyema had been present a month or more without treatment.

There is obviously no reason for satisfaction with our diagnostic acumen. Failure to diagnose empyema and promptly institute treatment is a most important cause of death.

Physical signs, particularly in children (Penberthy), are apt to be misleading. Certainly suitable roentgenograms will give far more, and more

accurate, information about intrathoracic conditions than will one's too imperfect senses. Roentgenograms in frontal and lateral planes will almost invariably demonstrate even small amounts of intrapleural fluid and, if properly interpreted, will provide accurate information as to its whereabouts. It is a simple matter to insert a needle and remove pus for examination in order to determine its physical and bacteriological characteristics. Oldberg believes that even with roentgenograms alone one may distinguish between pus and a serous effusion. The practical value of this differentiation by means of roentgenograms is doubtful.

Piot strongly objects to the fact that the roentgenologist is too closely attached to his laboratory and argues that it is only by taking roentgenograms at the patient's bedside early in the disease, while he may still be too ill to be moved, that a prompt diagnosis can be made. If pulmonary abscess or encysted or interlobar empyema occurs, Piot believes that only in this way can a satisfactory differentiation be made before perforation into a bronchus occurs.

Duplant also believes that only by early and repeated roentgenological examinations can the diagnosis of interlobar empyema be made before it is suggested by a sudden vomica; treatment before perforation into a bronchus may be effectively carried out.

Thomas states that roentgenograms should be made in all cases of empyema before operative treatment is undertaken, and aspiration of pus should be done only after the diagnosis has been made and then only as a prelude to operation or therapeutic aspiration.

Suitable roentgenograms taken in anteroposterior and lateral and, if necessary, oblique projections provide an accurate means of localization of pus prior to aspiration. Definite localization is of particular importance when diagnostic aspiration of an encysted empyema is to be attempted. Certainly such a procedure would save many a patient the distressing experience of the "70 times in 70 places" aspiratory attempts advocated by Osler when empyema has been suspected. I believe that the importance of roentgenograms in the diagnosis of empyema cannot be overestimated and, certainly, roentgen examination should never be omitted before operation.

Aspiration remains the final and, in fact, the only definite means of diagnosis. The evaluation of clinical signs and symptoms and the interpretation of roentgenograms may all be misleading. A thick pleura, pulmonary infiltration or fibrosis, solid tumors, and fluid-filled cysts may produce physical signs and roentgenographic appearances that are similar to those of empyema. Pulmonary atelectasis, since it causes mediastinal and tracheal deviation toward the affected side, may thereby be differentiated from fluid or pus in the chest because the latter most frequently pushes the mediastinum toward the opposite hemithorax. It is true that in rare cases the aspiration of pus from within the thorax may not mean empyema; but such cases as those described by Shaw, infected pulmonary cysts or tumors, and the transpleural aspiration of pus from a subphrenic abscess are rare indeed. The actual demonstration of pus is of importance in determining the presence of empyema, its site, the nature of the infecting organism, and the physical characteristics of the pus. However, aspiration of purulent fluid may in itself be misleading. Graham, Singer, and Ballon state, "It is perhaps advisable to call attention to the fact that nearly every case of acute pneumonia will reveal some fluid in the pleural cavity if an aspiration is performed. This fluid is serofibrinous or serohemorrhagic. Even though leucocytes and bacteria may be found in it on microscopic examination, it does not indicate an empyema in the sense of a true abscess. In most cases this fluid will be absorbed as the pneumonia clears. Statistics, therefore, based on the recovery of such patients after aspiration or continuous closed drainage are often misleading." Michalowicz has demonstrated that in children who are perfectly well aspiration in the diaphragmatic sulcus will usually be productive of a few drops of fluid which contain a small number of what seem to be pleural endothelial cells. He has found that in children with lobar or lobular pneumonia the pleural effusion passes through several forms: (1) yellow or slightly cloudy fluid containing a more or less considerable number of endothelial cells; (2) cloudy fluid containing endothelial cells as well as a small number of white blood cells, particularly lymphocytes; (3) cloudy sterile fluid containing polymorphonuclear leucocytes; (4) infected cloudy fluid containing polymorphonuclear leucocytes as well as pathogenic microörganisms; and (5) purulent fluid. In the development of such an effusion the metamorphosis to frank empyema may stop short of the final stage of purulent fluid.

Olesen and Hansen have developed a method for the recognition of empyema in its earlier phase when the pleural exudate is still serous or only slightly turbid. The cells from the exudate are stained by a supravital staining method that differentiates between living leucocytes, which absorb neutral red in their granules, and dead ones, which cannot be stained by this method. In

7 cases of pleurisy in which the fluid was of a serous or turbid appearance it was found that none of the leucocytes could be stained; that is, they were dead. In each of these cases empyema developed in from two to sixty days. On the other hand, in 101 cases in which the exudate was of similar appearance but in which all the leucocytes were stained by the supravital method, no empyema developed.

Aspiration of pus before operation is of further importance since it is the only definite means for determining the proper site for drainage. In discussing the treatment of interlobar collections of pus, Harrington believes that it is important to leave the aspirating needle in place when pus has been obtained and to operate immediately, since it is only in this way that a direct approach to the pus can be made. The practical importance of this method is doubtful, and the necessary moving about of the patient is dangerous when the needle is left in place. If the position of the arm at the time of aspiration and the site of the productive aspiration are kept in mind, reinsertion of the needle when the patient is on the operating table should again reveal the exact site of the pus.

The importance of determining the causative organism in all cases of empyema cannot be overemphasized. There is almost universal agreement that pure tuberculous empyema should rarely, if ever, be treated by any means other than aspiration of the pus, or aspiration of the pus and pleural lavage with a chemical solution such as azochloramide. It is, therefore, essential that pyogenic organisms be demonstrated in the pus before drainage. It is well to remember that even pure tuberculous empyema may closely simulate the pyogenic variety. For this reason Alexander insists that in every case of empyema pyogenic organisms should be demonstrated by smear or culture before drainage is done. Occasionally, and particularly in long-standing cases, the pus may be sterile despite all methods of examination. If tuberculosis can be excluded in such cases, drainage should be used to relieve the patient of pus, which is none the less damaging because it is sterile. Kinsella believes that when no organisms can be found on smear or culture of the pus from empyema, tuberculosis or malignancy should be suspected. He further points out that the tubercle bacillus may be easily overgrown by a secondary invader. At times pus may be sterile on culture because it has been planted on media too long after having been removed from the chest. Positive cultures may be obtained in some of such cases by immediately inoculating the proper culture media with it.

However, despite universal agreement on this principle, there still occur cases in which pure tuberculous empyema has been treated by open or closed drainage with inevitable secondary infection and a disastrous outcome, and only rarely with success.

The physical characteristics of the pus are of distinct importance in determining the proper time for drainage. White has proposed a rough test and believes that the pus is thick enough for safe drainage if at the end of twelve hours there is not more than 10 per cent supernatant fluid in a test tube partially filled with pus. Fitzgerald thinks that operation should not be carried out until a positive pressure in the pus has been registered manometrically. Pearse has made determinations of the specific gravity of the pus in 36 cases of empyema caused by the pneumococcus, the streptococcus, and the staphylococcus. In all cases there was progressive increase in the specific gravity which reached a constant level in about twenty-one days. He believes that open drainage is safe when this level has been reached. Suzman finds that manometric readings of the intrapleural pressure are of considerable help in determining the time for drainage because if the pressure readings vary with respiration the infection is widespread and without localization, whereas a fixed pressure indicates that there is a localized collection of pus and that the mediastinal structures are sufficiently fixed to allow safe drainage.

Other methods for determining the proper time for drainage have been proposed. Berman has used a method which is based on the fact that in normal individuals the mediastinal shadow is narrowed during inspiration and widened during expiration. This condition prevails throughout the course of empyema until localization has taken place. After this there is little or no movement of the diaphragm or mediastinum on the affected side. Using this method of fluoroscopic observation as a criterion, operation was carried out as soon as fixation occurred. In 27 cases he found that adequate localization and fixation were present in from seven to ten days, although in most cases the pus was still thin. Before this method was instituted for determining the fixation of the mediastinum it was found that thick pus did not occur until from twenty to thirty days after the onset of symptoms. Therefore, operation could be carried out earlier and consequently the postoperative period was shorter. Graham believes that in acute empyema repeated aspirations should be carried out until the exudate has become "frank creamy pus," since at that time

open drainage can be performed safely. Mason found that in children the proper time for drainage was approximately eighteen days after the onset of pneumonia.

Underlying these methods for determining the proper time for doing a rib resection for empyema is the principle of avoiding an open pneumothorax in the early stages of the disease. Fixation of the mediastinum and localization of the pus to a definite, walled-off abscess are essential to the safe performance of rib resection, and essential to a slightly lesser degree to the safe performance of closed intercostal drainage. Although I have had no experience with the method proposed by Berman, it is probable that fluoroscopic determination of mediastinal fixation, when correlated with the physical characteristics of the pus, will provide valuable information concerning the proper time for drainage. However, fluoroscopic observation and interpretation of the findings requires considerable experience and familiarity with intrathoracic dynamics.

Empyema does not always conform to the pattern that is expected. In location the pus is usually found in the lower thorax, but it may be loculated in any part of the pleural cavity. Kautz and Pinner have reported 3 cases of periapical empyema; in each case the diagnosis was proved by post-mortem examination. They have been able to find 20 similar cases in the literature. The diagnosis should be suggested by the clinical course and confirmed by roentgenograms which are indispensable in such cases. Aspiration of pus and subsequent surgical drainage can be readily done after localization by means of anteroposterior, oblique, and lateral roentgenograms.

The pus from empyema, if not drained surgically, may burrow in many directions. Perforation into a bronchus or the development of empyema necessitatis are the most common means of spontaneous drainage. Perforation into the trachea, esophagus, pericardium, blood vessels, or mediastinum may also occur. Occasionally the pus may penetrate the diaphragm to the peritoneal cavity or extraperitoneally. Deane has described a case of empyema on the left side which was unrecognized for three years. Eventually the pus presented in the left loin with signs similar to those of a perinephric abscess.

Blauvelt has reported a patient with empyema in which perforation of the esophagus occurred after drainage by thoracotomy. He has also found 8 similar cases in the literature. In these cases treatment has been varied: gastrostomy, feeding through a Rehfuss tube, and simple drainage of the empyema. If the fistula persists after drainage, closure through the thoracic wound might be feasible. Knauer has reported a case similar to Blauvelt's.

Renck has had an unusual case in which perforation occurred to the opposite pleural cavity through a communication at the level of the fourth rib. At autopsy the perforation was disclosed and mediastinal herniation was ruled out.

Birch has added still another route which pus from empyema may take. In his patient the pus infiltrated through the vertebræ into the spinal canal and caused paraplegia. There was some doubt in this case as to whether the empyema preceded the suppurative myelitis, whether the opposite sequence occurred, or whether both conditions started simultaneously as part of a septicemia.

Empyema may have serious effects upon contiguous structures. Dickinson has recorded a case of eventration of the diaphragm following drainage of empyema on the left side. The diaphragm was simply in a very high position but there was no true herniation. The patient's symptoms of pyloric obstruction were relieved by suture of the stomach to the anterior abdominal wall in a lower position. Parsons has reported the herniation of the stomach through the diaphragm in an area which had been weakened by empyema two years before. The diaphragmatic opening was closed by means of linen sutures.

Hill had a patient who, three weeks after drainage of an empyema on the left side, noticed that his left hand, arm, axilla, and shoulder did not sweat and that these portions of his body were hot and dry. This condition persisted for about one month. Hill believes that there was some disturbance of the thoracic sympathetic trunk where it lies in proximity to the parietal pleura and that the disturbance was caused by the contiguous empyema.

TREATMENT

Any consideration of therapeutics in empyema should stipulate what is to be accomplished. The first aim should undoubtedly be to save the lives of those individuals who might otherwise die of the disease. Secondary to this all-important result are: (1) complete evacuation of the pus; (2) rapid elimination of toxicity and systemic effects; (3) sterilization and subsequent complete closure of the cavity with obliteration of all foci of infection; (4) complete healing of the external wound; (5) restoration of the normal respiratory function of the lung; (6) restoration of the patient to his normal social and economic position; (7) the avoidance of chronic empyema and recurrences;

and (8) the accomplishment of all these desired results in as short a time as possible. Any method of treatment should be evaluated primarily by these criteria. Further evaluation of the method should concern its applicability to most types of empyema, the extent of its adaptability to the varying talents of physicians and surgeons, and its demands upon the time, patience, and skill of the nursing and professional personnel under whose care the patient will be. The latter factors will render a method absurdly impractical in an undermanned rural hospital, while it may give brilliant results in a highly organized clinic in which the attending personnel outnumbers the patients. Furthermore, I believe it is true that the average surgeon will operate on very few patients with empyema in the course of any year. The method of drainage to be used, therefore, should be one that will not too strenuously tax the memory and capacity of the assistants and nurses in providing the extremely important proper postoperative care, since when cases are few the necessities of postoperative care will not have become familiar through repetition.

In short, the simplest method that will produce the desired results is undoubtedly the best one.

With these requirements for satisfactory treatment in mind, we can consider the methods that have been proposed to achieve them. Differences of opinion have established two main schools of thought—the open method of drainage and the closed method. Seemingly, the cleavage between the proponents of the two methods is as definite as that between the Big Endians and the Little-Endians of Lilliput. (The aim of each of the quarrelsome factions in Swift's tale was to get at the egg and they differed only in the proper approach.)

It has long been customary to denote as "closed" those methods of treatment that rely upon the introduction of a catheter into the empyema cavity in such a manner as to prevent the exposure of the pleural cavity to atmospheric pressure. On the other hand, "open" methods, such as rib resection or the removal of a portion of an intercostal muscle bundle, allow more or less free ingress of air even if only momentarily at the time of operation. Strictly speaking, aspiration of pus by means of a needle and syringe is a "closed" method of treatment, but it is better to consider it apart from surgical methods.

The fundamental principles of the treatment of empyema cannot be reiterated too often, particularly since in recent years there seems to have been a tendency to attempt to achieve by so-called "conservative measures" what can be done satisfactorily only by prompt and adequate surgical intervention. Graham states as follows: "Two principles in the treatment of this condition (empyema) seem now to be firmly established, of which one is that empyema is essentially a surgical disorder demanding surgical drainage in nearly all cases. The other principle is that open drainage during the developmental stage is fraught with so much danger to the life of the patient that it should not be undertaken. Until the time comes when specific therapy against the infecting organisms is at hand it seems probable that these two principles will stand. They were recognized empirically by Hippocrates but because the underlying rationale of them was not understood until the period covered by the last two decades they were largely lost sight of. The terror of the epidemic which afflicted the United States Army camps in 1917 and 1918 was increased by the fact that many needless deaths occurred because the surgeons believed that early open drainage should be induced even before the inflammatory reaction had developed into an abscess. We now know that empyema in itself rarely causes death. The deaths which occur are due almost entirely to the pneumonia of which the empyema is only a complication or to the unwise creation of an open pneumothorax for drainage purposes during the period of active pneumonia. The particular danger to the patient lies in the fact that at that period of the disease his vital capacity may be only slightly greater than the tidal air requirement. The danger of death from asphyxia is therefore very great if the respiration is embarrassed still more by the presence of an open pneumothorax. Various improvements in the technique of drainage and in other particulars which have been introduced in recent years are distinct advantages. Closed drainage, to mention only one, is one of them. These matters, however, are essentially details. . . ."

Closed drainage (usually the insertion of a catheter between the ribs) was developed to circumvent the disasters that resulted from opening the thorax in the acute stage of empyema before the mediastinum had become fixed and perhaps before the underlying lung had recovered from pneumonia. At present all agree that open drainage should not be instituted until fixation of the mediastinum has taken place.

The groundwork of therapy would be incomplete without consideration of the possible terminations of an empyema that has not been treated. Most obvious, of course, is the death of the patient from toxic exhaustion or metastatic foci of infection. Graham, as quoted, and Heuer

believe that empyema, in itself, rarely causes death, but a fatal outcome may result from complications of empyema. I cannot agree with this belief. The simple presence of pus within the thorax may certainly be fatal. Maes, Veal, and McFetridge have studied the records of 100 patients who died with empyema and found that in 40 of these the cause of death was only toxicity and subsequent exhaustion. Michalowicz believes that there are three other possible outcomes, and among 1,450 cases he found that external perforation with the development of empyema necessitatis occurred in 12; and internal perforation with complete or partial evacuation of the pus through a bronchopleural fistula occurred in 19 cases. The third possible eventuality, spontaneous resorption, did not occur in any of these cases.

Recovery from empyema may be spontaneous or at least it may occur without the physician's assistance in evacuating the pus; however, this occurs very rarely. Bowen reported 2 patients who recovered after spontaneous drainage through a bronchopleural fistula. Hartfall and Pyrah have treated a patient with two distinct empyema cavities: one of these, in the posterior subapical region, was cured after drainage by rib resection; the other pocket was paramediastinal and closed after spontaneous drainage through a bronchial perforation. Oetken has reported the complete recovery of a patient with empyema due to the pneumococcus Type XIV; the only treatment was the oral administration of dimethyl-disulfanilamide (uliron). Tixier and Eck are enthusiastic about the use of sulfanilamide derivatives in the treatment of streptococcus empyema in those patients who are too ill for surgery; they have successfully treated 3 such patients with the chlorohydrate of sulfamido-chrysoidine (rubiazol). Further cures without surgical intervention or repeated aspiration of pus have been reported by Tripodi, who successfully treated 2 patients solely by the intravenous administration of a 2 per cent suspension of animal charcoal. Pontieri, in analyzing 70 cases of empyema in children, found that 13 were treated only symptomatically and with the administration of an autovaccine; these were patients in whom the pus was not readily accessible (interlobar or mediastinal) or in whom repeated aspirations failed to demonstrate pus despite clinical and roentgenological evidence of its presence. Four of these 13 patients died. It is fair to inquire how many more drained through a bronchopleural fistula and in how many of the not-proved cases the diagnosis can be accepted. Mindful of the fact that many conditions in which there is not even pus may be miscalled "empyema," it is well to view with scepticism such reports of recovery without the evacuation of pus.

With a jaundiced eye one reads Burrell's case report of a boy who developed empyema from which "a sample of cloudy, slightly purulent, yellowish liquid was aspirated. It was sterile but contained pus cells and a large number of polymorphonuclears. No tubercle bacilli were found." No further aspiration was performed but the boy made a complete recovery. I doubt that such a case can be considered empyema.

Lester's experience with chemotherapy in empyema has been quite different. He has reported 4 cases of empyema in children, due to the hemolytic streptococcus; 3 of the patients had prolonged treatment with sulfanilamide, prontosil, or both, in doses that should have been adequate, and a definite effort was made to control the disease by means of these drugs and repeated aspirations. However, in all of the cases surgical drainage was necessary to effect a cure. In the fourth case sulfanilamide was used after operation. Lester does not believe that in these cases the empyema was much affected by the drug although the patients may have been slightly less ill than they might otherwise have been.

Brown has cured 2 patients with streptococcic empyema by the intrapleural injection of prontosil. Nicholson, in order to test the efficacy of sulfanilamide experimented on rabbits with streptococcic empyema. He found that the animals which were given prontosil intrapleurally died earlier, and more often had a positive blood culture than those which did not receive the drug. Nicholson thinks it very unwise to use prontosil intrapleurally but recommends its oral use.

The manner in which healing takes place in empyema is of great importance in planning a proper method of treatment. Carlson has experimentally verified Heuer's observations that empyema heals by the progressive formation of adhesions between the parietal and visceral pleuras. Carlson produced empyema in rabbits by the injection of aleuronat and a broth culture of staphylococcus aureus. He found that pus tends to form at the most dependent part of the thorax and that the remaining pleural space usually becomes obliterated by fibrous adhesions. Microscopic sections revealed that both pleural layers were replaced by granulation tissue and that subsequently fibrous tissue grew between approximated pleural surfaces. Carlson believes that the same process takes place in clinical empyema.

Allison agrees that healing takes place by this gradual and steady process of adhesion of the visceral and parietal walls of the empyema. He

thinks further that inequalities in the rate of healing at different points depend on differences of elasticity in the visceral and parietal walls. Ideally, healing should progress centripetally with the drainage point as a center. Since proper allowances for anatomical readjustments should be made, he thinks that before the drainage site has been decided upon, as much pus as possible should be aspirated and a very small amount of air injected. Roentgenograms should then be made to determine the shape, position, and size of the cavity after the relief of pressure within it. Despite the theory of centripetal progression of the "healing edge," Allison believes that the proper site for drainage is at a dependent point.

Many methods of treatment of empyema have been proposed. However, they all fall roughly into four classes: (1) the administration of drugs of various sorts; (2) aspiration of pus with or without the introduction of air or chemical solutions; (3) closed drainage in which a determined effort is made to exclude atmospheric pressures from within the thorax; and (4) open drainage by which the negative intrathoracic pressure is not so scrupulously guarded. However, it must be remembered that the apparent distinctions proposed by advocates of the last two methods are not very definite. Thus drainage by rib resection and the insertion of a large rubber tube is certainly, if only momentarily, an open method, but air can subsequently be as successfully excluded from the pleural cavity by this method as by the closed method. And conversely, the careless aspiration of pus by means of a needle and syringe may allow the ingress of just as much air as that which enters during the resection of several ribs.

THERAPEUTIC ASPIRATION

There is no dispute but that aspiration (by means of needle and syringe) as a method of diagnosis is an important and never-to-be-neglected procedure. Of equally great value is the use of repeated aspirations of pus preliminary to operation. By this means toxic symptoms may be alleviated and intrathoracic pressure reduced until such time as the mediastinum has become stabilized and operation may be done safely. Therapeutic aspiration, unfortunately, does not enjoy any such secure position. Although, occasionally, complete and permanent cure may be effected by aspirations which are done preliminary to operation, this is fortuitous. Those who advocate repeated aspirations of pus as the only treatment believe, "No more good can be accomplished by removing the pus through a hole in the chest than by a needle" (Pollack). Perhaps this is true, but certainly more good can be done by keeping the cavity empty at all times than by emptying it intermittently. They believe that the procedure is to be most recommended for infants, who withstand operation less well than children and adults. This method is less distressing to the patient since he is spared an operation, the discomfort of wearing a tube, and the annoyance of pus-soaked dressings. It is thought by some that recovery is more rapid and the period of hospitalization shorter. On the other hand, there are those who believe that treatment by repeated aspirations holds only a limited—and, indeed, even a questionable—place.

Aguirre is of the opinion that this method should be used only in small and encysted empyemas, and, even in such cases, if four or five aspirations do not effect a cure or a considerable reduction of the toxicity, then thoracotomy should be done. Bohrer believes that aspiration as a curative measure is applicable in only a very few cases. Fitzgerald deprecates as dangerous the delay that may be caused by a futile effort to cure empyema by aspiration. Gezelius, among 159 children with empyema, had 15 who were treated by this method and 10 of these died; however, it is only fair to emphasize that these were the patients who were too ill to tolerate other operative measures. Mihara thinks that aspiration is unsatisfactory. Schneegans seems convinced that it is the best method for treating children. On the other hand, Wangensteen thinks that aspiration with a needle does not provide adequate continuous drainage and that, therefore, it is inferior to other methods.

Proper evaluation of aspiration as a method of treatment should be based upon a comparison of it with the other acceptable methods of treatment in respect to mortality, duration of toxicity, number of failures, and duration of convalescence. Such figures may be obtained from reports of series of cases that have been treated only by this method, and it is to be expected that only those workers who have enjoyed considerable success will deem their results worthy of publication. A second source of information is large series of cases in which many therapeutic measures have been tried. These figures may be misleading since aspiration may have been used only in very ill patients or there may be included, as having been treated by aspiration, patients who died after a few aspirations which would merely have been preliminary treatment had the patients lived. So the statistics are not entirely reliable.

Arnesen has reported 12 cases of postpneumonic empyema treated by multiple aspirations; his

method has been to remove all the available pus and then wash the cavity with a weak aqueous solution of iodine or rivanol. The number of punctures varied from two to seventeen and the duration of treatment from three to twenty-two weeks; there were no deaths and apparently none of the patients required operation.

Bilderback and Goodnight have treated 32 children by the aspiration of pus and replacement with air. Of these patients, 9 or 7.7 per cent subsequently had to have closed drainage. In the remaining 23 the death rate was 4.3 per cent and the average hospital stay was forty-two days from the time the diagnosis was made. The average number of aspirations was twelve.

In a series reported by Pontieri and Tecilazic, 23 children were treated by repeated aspirations with 13 deaths, a considerably greater mortality than resulted from closed or open methods of treatment. In large numbers of cases Steinke, Torres, Utter, Wallace, and many others have had similar experiences. Wallace's ultimate conclusion was that treatment by aspiration alone caused more deaths than did treatment by surgical measures and that mortality rates were higher with closed methods of treatment than with rib resection and open drainage; the lowest mortality in his cases occurred among those treated by means of rib resection and subsequent air-tight drainage.

On the basis of my own experience and the accumulated reports of others, it is my belief that aspiration with or without irrigations as a sole method of treatment of empyema is much less satisfactory than are surgical methods. Despite a few reports of small series of cases treated by aspiration with no deaths, in general the mortality rates are higher, morbidity is prolonged, and a large number of patients must necessarily be subjected to operation long after the most desirable time for surgical intervention has passed. Paradoxically, the so-called conservative treatment is actually more dangerous and less satisfactory than are the surgical measures that carry the qualifying adjective, "radical."

The injection of air after the aspiration of pus from an empyema cavity is rather generally done by those who believe that the multiple-aspiration method of treatment is of value. However, I think it is undesirable to do so. First of all, the basis of healing of empyema is the formation of adhesions between the visceral and parietal layers of the pleura. If then the pleural layers are kept apart by air, adhesions cannot and will not form and healing will be greatly delayed. It is particularly desirable that symphysis between the visceral pleura over the upper portion of the lung and the corresponding parietal pleura should take place early in the disease in order to localize pus at the base. In the presence of a pyopneumothorax, air will accumulate in the upper portions of the chest and prevent the formation of desirable adhesions. Another of the reasons for removing the pus is to relieve the pressure on the underlying lung; it does not seem logical, therefore, to maintain the collapse of the lung by substituting a pyopneumothorax for a simple pyothorax. Pus is also aspirated to relieve the patient of respiratory embarrassment and this is not satisfactorily done by maintaining partial collapse. Replacing pus under pressure by air under nearly as great pressure does not diminish the absorption of toxins from the infected surfaces; in fact, there is reason to believe that absorption is thereby increased. Brock found, in experiments on rabbits, that absorption through the pleura is greatly accelerated by dyspnea and even more so by inflammation of the pleura. From this he concludes, "The patient who is grossly dyspneic with a large pyopneumothorax and an acutely inflamed pleura is absorbing harmful substances at an alarmingly rapid rate."

One of the reasons for replacing pus with air in therapeutic aspirations is that the operator can thereby more safely remove a very much larger amount of fluid at one time than would otherwise be possible. The need for rather rapid evacuation of the fluid is sometimes pressing because of the patient's dyspnea, and because of the need for relieving him of the toxic effects of enclosed pus. This can be done even more safely by removing smaller amounts at more frequent intervals.

Still another objection to the deliberate creation of a pyopneumothorax is that the intercavitary pressures may not thereby be reduced sufficiently to obviate the possibility of infected air or fluid being forced out into the chest wall. It is considerably easier for infected air to be forced out of a needle track than for thick pus. Furthermore, the introduction of air into an empyema cavity may obscure the subsequent development of a bronchopleural fistula; this is of particular importance in small children, who may raise even large amounts of pus from the airways but promptly swallow it rather than spit it into a convenient container where it may be brought to the attention of the attending physician. Often the only certain evidence of a bronchopleural fistula is the demonstration in a roentgenogram of air in the pleural cavity.

Fluid should be aspirated frequently enough so that dyspnea does not occur. It is only in this way

that the harmful absorption of toxins can be reduced. To make these frequent aspirations more safe and more comfortable, Brock has suggested that, at the time of the first, a short incision be made down to the parietal pleura. The wound can then be kept open with a small pack which is removed when aspiration is to be carried out. In this way frequent aspirations may be done without undue discomfort and without the otherwise imminent danger of cellulitis of the chest wall.

It is justifiable, however, to introduce a small amount of air into certain loculated empyemas in order to map out their outlines accurately and thereby better to plan treatment.

Haines has reported the cure of a patient with three distinct pockets of pus by aspiration and air replacement; the causative organism was the staphylococcus aureus and operation was not resorted to because of the patient's precarious state. He does not recommend the procedure for routine use.

Aspiration combined with the intrapleural administration of chemicals has been successfully used in some cases. Aguirre believes that in children under two years of age aspiration and pleural lavage with optochin should be tried; however, if improvement does not occur, thoracotomy should be done; prompt open drainage should always be performed in putrid empyema. Boller has recommended that aspiration and the intrapleural injection of iodized oil be tried and he believes that this will be sufficient in most cases; however, in 3 of 8 reported cases surgical drainage had to be used. In any case with a high degree of sepsis, Boller believes that suction drainage by means of an intercostal catheter should be used immediately and that this should be reinforced by the instillation of iodized oil.

Greppi has reported 43 cases of empyema with 7 deaths (16.2 per cent). Thirty-six of these were caused by the pneumococcus and were treated by aspiration and the intrapleural administration of optochin; of these, 6 required subsequent rib resection and all 6 patients recovered. Of the remaining 30, 2 died. Greppi's conclusions are that this treatment will effect a cure in a reasonable number of cases and should be tried. However, from an analysis of other statistics he believes that equally good results can be obtained by aspiration alone without the use of optochin. He states that in only rare cases should surgical treatment be used in children under one year of age.

MacLachlan and his associates have had favorable results in treating 15 cases of pneumococcus empyema by aspiration and the instillation of about 100 c.cm. of a 2 per cent solution of hydroxyethylapocupreine. They have noticed that although pneumococci may be seen in smears after such treatment, the organisms will show the "Quellung" phenomenon and will not grow on media. Pontieri and Tecilazic have treated 22 cases of empyema in children by aspiration and the introduction of sodium taurocholate. Of these children 7 were cured, 7 died, and 6 required operation. The same authors found that only 4 of 18 surgical patients died.

Sworn and Cooper treated 3 patients by aspiration of the pus and the injection of from 5 to 20 c.cm. of a 5 per cent solution of sodium desoxycholate. They believe that the lysis of pneumococci which occurs under the influence of bile salts is sufficient to cure many cases of empyema. Anderson and Hart found experimentally that sodium chloride increases the susceptibility of pneumococci to lysis by sodium desoxycholate and they, therefore, recommend that in the treatment of pneumococcus empyema the drug be dissolved in a solution of sodium chloride of at least 1.5 per cent.

Tassovatz has reported success in 4 cases of empyema treated by aspiration and with optochin and Todd has cured a patient with streptococcus empyema of five months' duration by aspiration and pleural lavage with a 1:5,000 solution of merthiolate.

CHOICE OF OPERATIVE PROCEDURE

The choice of operation for the drainage of empyema must be made between several operations which fall into two groups. The first of these may be called open operations—not because air cannot be successfully excluded from the pleural cavity postoperatively, but because these operations allow visual, digital, and instrumental exploration of the pleural cavity for the identification of bronchial fistulas and possible accessory empyema pockets, the complete removal of all fibrin masses, and the opportunity for ensuring the proper placement of the tube. Open operations may involve the resection of one or more ribs, or may be done intercostally (Bohrer, Weinstein). Postoperatively open drainage may be maintained in such a manner that the free to-and-fro exchange of air between the pleural cavity and the exterior is prevented only by the presence of a gauze dressing over the drainage opening. Or a closed system of drainage may be set up by the use of a flapper-valve (Bohrer, Lilienthal) or, by the use of a water-seal, any kind of siphonage drainage with any degree of suction and with or without irrigation may be maintained quite as satisfactorily

after the resection of a rib as with the use of an intercostal catheter. The open methods of treatment need necessarily be open only long enough for the surgeon at the operating table to satisfy himself that he has provided adequate drainage and that there are no underlying conditions which will impede healing of the cavity.

Closed operations are those in which a catheter is inserted into the empyema cavity through an intercostal space without exposure of the parietal pleura. A trocar and cannula of a size large enough to allow the introduction of about a No. 18 F. catheter are customarily used. Modifications of this simple instrument are almost as numerous as the surgeons who have drained more than 5 cases of empyema. New models appear almost as frequently as those of automobiles, and are obsolescent almost as soon as new airplanes, which are thought by some to be obsolete at the time of the first test flight. The search still goes on for the perfect instrument that will provide adequate drainage without injury to the patient. No one instrument enjoys very widespread acceptance and usually the partisans of the use of the instrument are closely gathered about its designer.

Closed operations differ fundamentally from open operations in that the former do not allow inspection and exploration of the empyema cavity. Identification of bronchial fistulas must be inferential; the recognition of accessory pockets depends upon the postoperative course and roentgenograms; for the evacuation of fibrinous masses reliance must be placed upon suction and irrigating solutions; and, finally, assurance of dependency of drainage is impossible at the time of operation but must be hoped for and verified by the patient's response to drainage and by postoperative roentgenograms.

Comparisons of the two methods can best be obtained in reports from centers where all methods have been in use for the same periods of time. Thus Wallace's review of 363 cases of empyema in children from the Royal Edinburgh Hospital is of significance. His report deals with all methods of treatment and he has emphasized the fact that "each type of procedure utilized was adopted by choice and not by the expediency of the child's illness." Sixty children were treated by repeated aspirations, of whom 23 (38.3 per cent) died; in 66, closed operations were used and 16 (23 per cent) died; 222 had open operations and of these 32 (14.9 per cent) died. The differences are quite striking and Wallace concludes that the most adequate and most successful treatment of empyema in children is by means of rib resection after the mediastinum has become fixed by adhesions.

White and Collins have reported 317 cases from the City of Washington. In this series, treatment by aspiration alone had a mortality of 26.2 per cent; with closed drainage 11.4 per cent of the patients died, and 23.6 per cent of the survivors needed secondary rib resection. The mortality of rib resection was 6.5 per cent. The lowest mortality was 3.8 per cent, in 51 cases treated by double rib resection and packing (so called Connors' operation).

On the other hand, Utter has reported 282 cases of empyema in children. Fifty-three were treated by aspiration; of these, 20 (37.8 per cent) recovered, 9 (17.9 per cent) died, and 24 (45.4 per cent) required secondary operation. Closed intercostal drainage was used in 48 and of these 33 (68.7 per cent) recovered, 8 (16.7 per cent) died, and 7 (14.6 per cent) needed secondary rib resection. One hundred and forty-five had primary rib resection and 89 (61.4 per cent) recovered, 49 (33.8 per cent) died, and 7 (4.8 per cent) developed chronic empyema.

It is quite possible that the relatively high mortality with rib resection, as reported by Utter, was due to too early operation, i.e., the creation of an open pneumothorax before the empyema had become localized, and the mediastinum and lung fixed by pleural adhesions.

Mihara has reviewed 121 cases from hospitals in Fukoaka, Japan. Closed intercostal drainage was used in 19 cases with 5 deaths (26.3 per cent) and 8 subsequent rib resections. Open drainage (rib resection) was used in 69 patients with 9 deaths (13 per cent) and 6 who had to have subsequent thoracoplasty for chronic empyema.

Burpee used intercostal closed drainage in 21 children with 3 deaths (14.3 per cent), and rib resection in 37 children with 6 deaths (16.2 per cent).

Hochberg and Kramer have reported 300 cases of empyema in children under fifteen years of age. Closed intercostal drainage was used in 64 patients and 11 (17.2 per cent) died; open drainage with rib resection was used in 124 children with only 7 deaths (5.6 per cent).

Mason's strong recommendation of rib resection as the method of choice even in children is based on his experiences with closed operations which were performed on 30 children with 6 deaths (20 per cent); rib resection in 72 children gave a mortality of 6.94 per cent. Furthermore, 6 of the survivors in the first group had to have subsequent rib resection.

From all this it would seem that even in children, drainage by rib resection *at the proper time* is a safer procedure than any other form of treat-

ment. There is, furthermore, no significant difference in the length of postoperative hospitalization.

Of course, even more strikingly low mortalities have been reported by authors who have almost exclusively used one method or the other. Mortality rates have varied from 0 in 53 cases to 33.8 per cent in 145 cases. The obvious inference is that a low mortality is considerably dependent upon local conditions. The universal mortality in patients of all ages as gleaned from more than a score of reports in the literature is about 15 per cent.

New operations which, in my opinion, are worthy of special mention are those of Connors and Weinberg. Connors advocates the following operation for the drainage of empyema and the prevention of chronic empyema:

An incision is made along the line of the rib over the central portion of the empyema cavity. Two or three inches of two ribs are resected subperiosteally, and the intercostal muscles, vessels, and nerves are removed *en masse*. A large window is made in the parietal pleura, and the cavity is cleared of pus and fibrin and then packed fairly tightly. The packing is usually removed on the second or third day and subsequent packs are used down only to the parietal pleura. Seventy-four cases have been operated on by this method, 55 adults and 19 children: the mortality was 6.6 per cent. Of the 5 patients who died, 2 had developed severe contralateral pulmonary infection, 1 had had an overwhelming toxemia following miscarriage and pneumonia, and the 2 others died of complications. Carnazzo has used this same method in 20 patients without any deaths.

Weinberg's operation was devised in a search for a simple procedure because it had been his feeling that "anyone who reviews the various methods of treatment which have been devised in recent years, particularly the closed methods, must be impressed by the complicated apparatus and details of management entailed in their use." The operation which Weinberg has used in 53 patients with no deaths is the complete excision of the intercostal muscle bundle between two ribs, together with the removal of the muscles which overlie the opening thus made. The pleura is widely opened and the opening blocked by a tampon of rubber tissue packed with gauze, which permits the escape of pus but prevents the ingress of air. His results have been excellent.

It must be understood that the operations advocated by Weinberg and by Connors must never be undertaken before pleural adhesions have formed sufficiently to insure against mediastinal displacement when the pleural cavity is opened.

Koster and his associates have been impressed by the striking omission from the literature on empyema of a consideration of the factors responsible for prolonged morbidity. From 1929 to 1934 they treated 118 cases of empyema by open drainage with rib resection. In 5 cases convalescence was greatly prolonged because of complications. In the remaining 113 cases an average of forty-five days elapsed between the institution of drainage and complete healing of the wound.

These authors believe that healing of an empyema cavity is greatly dependent upon the activity of the underlying lung. In order to increase the respiratory movements of the lung on the affected side they have induced a contralateral artificial pneumothorax. They report 21 cases of acute empyema treated by means of closed intercostal catheter drainage with contralateral artificial pneumothorax. Seventeen occurred in children up to the age of twelve and 4 in adults. In the children the average period until there was no more drainage of pus was fourteen days. In the adults the average duration of drainage was twenty-one and two-tenths days. In 1 case, a child one year of age died about two hours after the administration of the first pneumothorax. Death was attributed to air embolism. In another case, a girl of twelve, a spontaneous pneumothorax developed and apparently the child's life was saved by continuous aspiration of the air through an intercostal catheter. Several of the patients developed subcutaneous emphysema subsequent to the administration of the pneumothorax.

In the reproduced roentgenograms the mediastinal structures and trachea are pushed into the infected side of the chest by the presence of the large pneumothorax on the contralateral side. The authors believe that this is helpful in promoting early closure of the cavity and that, furthermore, the increased respiratory demands on the lung underlying the empyema cavity aid in its reëxpansion and the subsequent obliteration of the cavity.

This method of treatment is designed purely to shorten the period of convalescence and is in no way expected to decrease the death rate from empyema. It is not a justifiable procedure because: (1) it seems inadvisable to increase so greatly the activity of a lung which has so recently been the site of pneumonia and in which there may still be residual infection; (2) it seems undesirable to plan deliberately for distortion of the mediastinal structures and the trachea; (3) absorption of toxins is greatly increased by dyspnea; (4) spontaneous pneumothorax is an ever-present danger in the induction of any pneumothorax and may at times be fatal; and (5) air embolism, which caused 1

death in Koster's series of cases, is a serious reason for not lightly undertaking this method of treatment. The greatest objection is that it is a procedure which carries with it, in the authors' series, a mortality rate of 5 per cent and a 10 per cent occurrence of serious complications. Such a high mortality rate for a procedure, which is designed only to reduce by a few days the time spent in the hospital, makes this method of treatment absolutely unjustifiable.

With so many types of treatment to choose from, it is manifestly impossible for any one person to have had a wide experience with all of them. I believe that there is no doubt but that surgical drainage will be attended by the lowest mortality, the highest percentage of complete cures, and the fewest recurrences. We have long used with excellent results a plan of treatment that depends on the following factors:

1. A proper period of aspiration to reduce toxic absorption and intrapleural pressure and to allow time for fixation of the mediastinum.

2. When the pus has become walled off, a segment of rib at the most dependent point of the cavity should be removed and a large rubber tube inserted in the cavity.

3. This tube, which should be sufficiently large to allow complete drainage of all pus and fibrin masses, should fit snugly in the pleural opening in order to be air-tight.

4. The distal end of the tube should be connected to a suction apparatus that will produce varying degrees of negative pressure as desired.

5. The tube is not to be removed permanently from the chest until the intrapleural cavity is completely closed.

This method of treatment has been found to be entirely satisfactory in all types of non-tuberculous empyema and in infants as well as in children and adults. Very rarely, and then only because of the very precarious condition of the patient, drainage by means of an intercostal catheter may be resorted to, but only as a preliminary to an almost inevitable rib resection.

INFECTIONS OF CHEST WALL

It is difficult to determine how often the chest wall becomes infected about a drainage tube. However, it is my belief that infection occurs frequently about those tubes that are tightly sewn in place. Some champions of the closed intercostal drainage method believe, "It is most important that the skin incision should be as small as possible so that when the catheter is in position the skin closes around it and helps make the wound air-tight." On the other hand, others agree with Hart who thinks it is very important to make a skin incision large enough to allow free drainage if there is any leakage of pus around the tube.

To be censured is the rather widespread custom of tightly closing the wound about a drainage tube which has been put in place after rib resection. The error of this procedure should be, but is not, all too apparent. The distressing spreading infection that may occur therefrom is, fortunately, infrequent, but the credit for this infrequency belongs to someone other than the surgeon who sews up a grossly infected wound.

Brandberg has reported a case of progressive gangrene of the skin following operation for pleural empyema. The operation was a rib resection and, although a complete description is lacking, the author describes the first changes in the skin as occurring "about the suture channels in the operative wound." Of still greater significance is the fact that "in the pleural cavity was one-third of a litre of evil smelling matter in which streptococci could be demonstrated." It is entirely possible that an anaerobic organism played no small part in the extensive gangrene of the skin that started about ten days after the operation. The patient recovered but only after numerous excisions of the skin and subsequent skin grafts.

Brandberg found 4 similar cases in the literature. Stewart-Wallace has reported a similar case of slowly progressive gangrene of the skin and subcutaneous tissue secondary to rib resection for drainage of empyema. In his case, too, the skin and underlying tissues were tightly sutured about the drainage tube in order that an air-tight system might be set up. Six days after drainage there was obvious infection of the wound and therefore the skin sutures were removed. The infection spread rapidly, soon involving an area of skin and subcutaneous tissue extending from the opposite iliac crest over the entire back and up to the occiput. Despite varied treatment—local antiseptics, diphtheria antitoxin, staphylococcus toxoid, and autogenous vaccine—the patient died thirty-two weeks after operation. It was not until after death that the infection was recognized as being due to the symbiotic activity of a microaerophilic streptococcus and the staphylococcus. (Meleney has admirably described these infections and offered a sound plan for treatment consisting of complete excision of all infected tissue and the use of zinc peroxide in the wound.)

These cases should be a stern warning against the practice of tightly closing empyema wounds around a drainage tube and thereby favoring the burrowing of infected material from the pleural cavity into the subcutaneous tissues.

If air-tight drainage is necessary and advisable, this can be obtained without difficulty by achieving a snug fit of the tube in the *pleural* opening, packing the otherwise open wound with vaseline gauze, and, as an added precaution, passing the drainage tube through a rubber sponge which tightly hugs the chest wall. Drainage from within is not thereby impeded but the ingress of air is prevented.

POSTOPERATIVE TREATMENT

Postoperative treatment other than care of the empyema cavity, dressing of the wound, and attention to the drainage apparatus has not received a proper share of attention. Particularly in children the care of the patient is of utmost importance. Bisgard has stressed the importance of preventing permanent scoliosis and of counteracting the temporary scoliosis that accompanies acute empyema. That scoliosis is an important feature in empyema has been brought out by Andrus and Holman who found that 46 (92 per cent) of 50 patients with acute empyema had roentgenological evidence of scoliosis before treatment was instituted.

Cabitt and Hurwitz believe that reliable estimation of the healing of an empyema cavity can be made only by roentgenological examination after the cavity has been filled with iodized oil. They have found that ordinary films are misleading and that the amount of saline solution that may be used in measuring the capacity of the cavity is usually much less than the actual size of the cavity. However, by the use of roentgenograms after the instillation of iodized oil, accurate determinations of the size of the cavity and the progress of healing may be made. Since too early removal of the tube is a frequent cause of recurrent empyema, Cabitt and Hurwitz think that the drainage tube should be removed only after the injection of lipiodol demonstrates a completely obliterated pleural space.

In measuring the capacity of a cavity by filling it with saline solution, or in mapping its outline with lipiodol, care must be taken to have the drainage opening uppermost and to insert the instillation catheter to the most distant point of the cavity. Otherwise the solution may not reach all portions of the cavity.

Schenck and Hochberg believe that physical examination is of small value in following the course of an empyema. They are convinced that it is only by the use of frequent roentgenograms that proper after-care can be given.

Roentgenograms, to be of use in postoperative empyema, should be taken by the Potter-Bucky technique or some similar method. Roentgenograms taken with ordinary chest technique are unlikely to provide for sufficient penetration of the thick pleura to present accurate information about the empyema cavity.

The use of blow-bottles or rubber balloons as an aid to early reëxpansion of the lung has been variously advocated and decried as worthless or even harmful. Gumpel believes that such respiratory exercise is of value and has described a system of blow-bottles fashioned from a mason jar, a water pitcher, two glass drinking tubes, and several lengths of rubber tubing. The virtues of this apparatus (ersatz, as it is) are that it is cheap, easy to make, and light in weight; and its use can be readily supervised by the patient. Thomas also advocates the use of blow-bottles to aid in pulmonary reëxpansion.

Roberts has found that blow-bottles and balloons are of little value and advocates instead the controlled, inspiratory exercises developed by McMahon. Roberts has said, "I consider that this is one of the greatest advances in the treatment of empyema of late years, and properly applied it has rendered the incidence of chronic cavities much less." These exercises are designed to act upon that part of the chest most in need, and it is surprising that even small children can learn to accentuate the respiratory excursions of that part of the chest which is most in need of the exercise.

Of far greater value than blow-bottles or respiratory exercises in promoting early reëxpansion of the lung is the use of suction of any desirable degree. This may be used satisfactorily after rib resection and has repeatedly proved efficacious in shortening the period of postoperative convalescence and in preventing the development of chronic empyema.

Mitman has used the Drinker respirator to promote expansion of the lung in cases in which there has been no noticeable expansion after many weeks. In 1 case which was so treated the lung, which had been collapsed for fifty-four days, completely reëxpanded after four daily treatments of an hour in the respirator at pressures of from 0 to −18 cm. of water; the wound also healed within six days. In another case the result was not so striking but there was considerable improvement of a long standing empyema.

Green believes that "good medical care with attention to the nutrition of the patient" is one of the fundamental principles of treatment of empyema. Ramírez has stressed the importance of postoperative supportive treatment and the importance of close coöperation between the surgeon

and pediatrician. He believes that in addition to a high-caloric, high-vitamin diet, cardiovascular tonics should be used when necessary; and drops of eucalyptol and gomenol should be introduced into the nose to disinfect the nasopharyngeal secretions. (The wisdom of this practice in children is decidedly doubtful because of the increasing frequency of development of lipoid pneumonia.)

Schneegans and others believe that frequent transfusions of whole blood are of great value in treating children who have empyema.

CHRONIC EMPYEMA

Brock has offered the most satisfactory answer to the troublesome question as to when acute empyema becomes chronic; he believes that empyema may properly be called chronic when the process of obliteration of the cavity has stopped or has become so slow as to be negligible.

The possible causes of chronic empyema—although not the relative importance of these causes—are generally agreed upon. Roberts has offered the following very satisfactory classification of the condition: (1) latent empyema, in which the empyema with or without bronchial fistula is not discovered for many months or even years; (2) persistent empyema, in which the empyema persists for an abnormal length of time after drainage; and (3) tuberculous empyema. Persistent empyema is due to: (1) too early removal of the drainage tube; (2) persistence of the infection in the cavity because the fibrin was not removed at the time of drainage, or the tube used did not have a lumen sufficiently large to allow adequate drainage; (3) non-dependent drainage; (4) a drainage tube which is too long or too short; (5) delayed expansion of the lung caused by thickening of the pleura, bronchopleural fistula, or fibrosis of the lung; (6) a foreign body in the cavity, usually a tube or other drainage material; and (7) unsuspected tuberculosis, actinomycosis, or neoplasm.

Brock and Bettman agree that by far the most common cause is premature removal of the drainage tube. Figarella believes that a non-dependent drainage site is one of the most important causes of chronicity. Hart has stated that 15 per cent of the chronic empyemas seen by him had a foreign body as the basis of their chronicity.

Whatever the cause, the consensus is that prevention is the best treatment. Certainly the only causes of chronic empyema for which the physician is not to blame are tuberculosis, actinomycosis, or a neoplasm, and occasionally a very large bronchopleural fistula. In any case prompt, proper, adequately supervised, and sufficiently prolonged treatment of acute empyema should offer reasonable insurance against chronicity of the infection. In Bohrer's series of 265 cases in children none developed chronic empyema. Utter has reported 282 cases of empyema in children and of these 6 required subsequent thoracoplasty for the cure of chronic empyema. The actual incidence cannot be accurately determined without better follow-up systems than are in use in most places. It is probably true that the majority of patients who develop chronic empyema during or after the care of one physician, go elsewhere for subsequent treatment.

Inasmuch as proper care will in most cases prevent the development of chronic empyema, the means of prevention should be considered. The ill effects of too early removal of the drainage tube can be circumvented only by leaving the tube in place until the entire pleural cavity has been obliterated and no cavity remains except the superficial wound; the latter should then be allowed to close—but firmly and from the depths outward. The proper time for removal of the tube can best be determined by taking roentgenograms after the instillation of iodized oil into the cavity.

The presence of large amounts of fibrin in the pleural cavity may cause a persistent infection; therefore, the removal of all fibrin is desirable. There is no doubt but that this can best be done by open thoracotomy, and least well done by aspiration through a needle. Irrigating solutions are of doubtful efficacy in dissolving fibrin.

Despite a few authors who disagree, effective drainage should be at a dependent point. In planning the proper site it should be remembered that the patient will spend most of his hours in a more or less erect position so the drainage tube should be as near to the mid-scapular line and as low as possible. The proper site for the drainage tube should be determined by careful study of roentgenograms and by aspiration of pus at the operating table. It is astonishing how many patients with chronic empyema recover after the resection of a rib at a level lower than that of the original drainage site which was not strictly dependent. As a corollary to this urgent need for dependent drainage, the drainage tube should be of the proper length. If it is too long and fits snugly into the pleural opening, no pus will drain through it until the level of the fluid is as high as the opening in the tube. If too short, the tube will not maintain the patency of the pleural opening. The inner opening of the drainage tube should be just within the parietal pleura and this proper length should be determined accurately by digital examination or by measuring with a sound. Of course, by put-

ting numerous windows in the sides of the tube, one at least will be dependent and then a longer length of tube can be placed within the cavity. However, fenestrations in a drainage tube will very quickly become filled with granulation tissue which will obstruct drainage through these openings and may even entirely fill the lumen of the tube. A long length of tubing within the chest adds the hazard of irritation and possible necrosis of the lung.

The rigid thickening of the visceral pleura that may prevent expansion of the lung can be prevented by prompt and complete drainage so that the underlying lung will not too long remain collapsed. The use of suction postoperatively will be of great value in overcoming the resistance to expansion of a lung covered by thick pleura.

Prevention of the development of a bronchopleural fistula may not be possible but perpetuation of it may be avoided by prompt drainage of the empyema. Simple drainage and the provision of an adequate outlet for the pus is usually all that is necessary to bring about the closure of a bronchopleural fistula that developed only because there was no other way out for the pus. Very large bronchial fistulas may persist after simple drainage and closure of them may be accomplished only by plastic operations.

Fibrosis of the lung as a cause of chronic empyema has been noted especially by Butler, who believes that the pulmonary fibrosis observed in chronic empyema may have slowly formed within an unexpanded atelectatic lobe and that this atelectasis is in some instances caused by bronchial obstruction. The obstruction is caused by the external pressure exerted by a pleural exudate upon a lobe or lobes still filled with pneumonic secretions. If the pressure is not relieved by drainage, the lobes do not immediately reëxpand but remain practically functionless and there is a consequent accumulation of secretions in the smaller bronchi, bronchioles, and alveoli. Since respiratory efforts are not in themselves sufficient to evacuate these secretions, aspirations through a bronchoscope should be carried out. About 2 per cent of all postpneumonic empyemas will be complicated by an atelectasis of one or more lobes of the lung on the affected side. This predisposes to chronicity of the empyema and unless relieved will lead to pulmonary fibrosis and the type of chronic empyema that can be cured only by a mutilating type of thoracoplasty. Such atelectasis should be suspected whenever a postpneumonic empyema fails to clear up within about a month and no other satisfactory explanation can be found. Bronchoscopic examination after the exclusion of other causes will provide the diagnosis. Endobronchial aspiration is the only feasible treatment. Butler has had 4 such cases among 189 cases of acute empyema.

The presence of a foreign body as a cause of chronic empyema is almost always due to carelessness on the part of the attending surgeon. Insecurely anchored drainage tubes or gauze packs, inattention to the importance of removing all that has been put into a wound, and carelessness in doing dressings are obviously reprehensible technical errors. Bone chips should not be allowed to fall into the cavity at the time of rib resection, and proper resection of a rib will almost always prevent the subsequent development of osteomyelitis in the rib. Overholt has proposed turning flaps of periosteum over the cut ends of the ribs, and Churchill has shown that osteomyelitis will seldom occur if the periosteum is cut squarely and exactly at the resected ends of the rib. In other words, bone should not be denuded of its periosteum beyond the limits of resection.

The presence of unsuspected tuberculosis or actinomycosis can be ascertained by careful bacteriological examination of the pus or by histological examination of a small piece of parietal pleura. Alexander believes that a piece of parietal pleura should always be removed for bioptic examination at the time of rib resection for drainage of empyema.

The first step in the treatment of chronic empyema should, in most cases, be redrainage at the most dependent point. The attempt should then be made to reëxpand the lung by suction and by breathing exercises. Not infrequently the use of negative pressure obtained either by means of a vacuum pump or a siphonage system will be sufficient. Lloyd has reported 17 cases of chronic empyema which were cured by continuous suction of from 12 to 16 in. of water. Even more highly negative pressures may be used with safety and effectively. Bernou, Canonne, and Marécaux have used negative pressures as low as minus 200 cm. of water and even as low as minus 50 cm. of mercury (minus 680 cm. of water). It is necessary to reduce the pressures to such low points gradually in order to avoid bleeding and possible torsion of the great vessels by mediastinal displacement. Usually such extreme pressures are not necessary.

McLellan and Tixier and others have reported cures of chronic empyema with suction methods.

If such measures fail to bring the lung in contact with the chest wall and thereby obliterate the cavity, then surgical measures are necessary either to fill the cavity with a graft of some kind or to collapse the chest wall onto the lung.

In the past, several operations have been proposed to make the stiff walls of a chronic empyema cavity softer and more yielding. Estlander and Schede have devised operations on the parietal walls to bring about closure, and Delormé has approached from the other side by decortication of the thick and unyielding visceral pleural scar. The Ransohoff operation of multiple gridiron incisions through the visceral pleura has also been used to facilitate the expansion of the lung. More recently partial extrapleural thoracoplasty with subsequent unroofing of the small remaining cavity by the Schede method has been used by many surgeons. At each stage of the extrapleural thoracoplasty the periosteum should be treated thoroughly with 10 per cent formalin to prevent too early regeneration of the ribs. By this method of extrapleural removal of the ribs a large cavity may be reduced to a very small one, which may then be easily unroofed without the operative risk and mutilation that is attendant upon an extensive Schede rib resection. Martin believes that the modern method of treatment should combine the method of Schede, namely, the removal of ribs, periosteum, intercostal muscles, and parietal pleura, and the removal of the visceral pleura (Delormé). He does not find necessary the entire removal of the rigid parietal and visceral pleura but simply enough of it to start healing, which will continue provided reinfection is avoided. By this method Martin has cured 20 of 26 patients with chronic empyema; the remaining 6 still had persistent fistulas and residual cavities.

Roberts has expressed his disappointment with the decortication operation of Fowler and Delormé and has no approval for the Ransohoff procedure. Furthermore, he believes that the Estlander and Schede operations carry an almost prohibitively high mortality of about 50 per cent.

The operation which Roberts uses follows a preliminary period of proper drainage. The ribs overlying the cavity are resected subperiosteally in as many stages as necessary; at each operation the drainage opening is sealed for a few days to prevent infection of the operative wound. Then the cavity is laid open along its anterior margin and the incision is continued around the apex of the cavity in such a way that the thickened parietal pleura with the overlying intercostal muscle bundles and periosteum form a pedunculated flap which is hinged posteriorly. Thus the blood supply of the flap is preserved. Where the visceral layer of thickened pleura joins the parietal layer posteriorly a wedge of fibrous tissue is removed so that the outer wall of the cavity can fall in contact with the inner wall. Gauze impregnated with flavin and paraffin is now placed on the outer surface of the flap and the skin and superficial muscles are sutured over it. A week later the wound is opened and the internal gauze removed; it is usually found that the cavity is obliterated by adhesion of its walls. The wound is then resutured over drains and an external pressure dressing is applied. Roberts has used this method successfully in 100 cases with only 1 death.

Wangensteen has proposed a method for the extrapleural removal of the ribs by means of extensive subcutaneous tunnelling through short anterior and posterior incisions. It is his contention that this obviates the need for an otherwise large and often shocking incision. The dangers of such blind removal of ribs are great.

Jachia thinks that in chronic empyema the Schede operation is frequently too much for an already debilitated patient to withstand and that, in addition, operating on the already infected pleura is frequently the cause of extensive suppuration. He prefers a combined Estlander and Schede procedure. In order to prevent rib regeneration, the periosteum which remains is painted with Zenker's solution.

Carter believes that there are three types of chronic empyema in which complete obliteration of the cavity does not occur even under ideal conditions of drainage: (1) secondarily infected tuberculous empyema; (2) non-tuberculous empyema that has lasted several years; and (3) chronic empyema complicated by a bronchial fistula. Since the first and most important requisite in the treatment of chronic empyema is to create ideal conditions of drainage, Carter believes that the chest wall should be widely opened by the resection of from 4 to 6 in. of two or three ribs at the lowermost portion of the cavity. The underlying thickened parietal pleura is excised. A large muscle flap of the latissimus dorsi and the trapezius muscle is mobilized widely around the sinus and preserved for future use in closing the cavity. After the wound has become clean, muscle flaps of the latissimus dorsi and trapezius for the lower portions of the cavity, the sacrospinalis group for the apical portion, and the intercostal muscles as available, are used to fill the cavity completely. The pectoral muscles can be utilized for an empyema cavity in the anterolateral thorax.

Garlock has reported the cure of chronic empyema of eight years' duration by means of a staged thoracoplasty and the closure of several bronchial fistulas by the insertion of muscle flaps into the fistulous openings. These flaps may be fashioned from the intercostal muscles or from the sacrospinalis if this is more accessible.

Gray has reported the use of the pectoralis major and the latissimus dorsi in the obliteration of large empyema cavities, and Racz has made similar use of the pectoral and dorsal muscles.

Bethune has used maggots in the infected wound that resulted after a partial Schede thoracoplasty for chronic empyema. After about twelve days of treatment with maggots the wound was clean, and healing was almost complete within six weeks.

Meade has found 14 cases of recurrent empyema among 869 cases of acute and chronic empyema. In these the recurrence had taken place after freedom from an open wound or toxic symptoms for from five weeks to thirty years. Presumably inadequate treatment at the time of the original operation was responsible. A residual cavity with thick walls in which infection may be latent is the usual cause of such recurrences.

SCOLIOSIS

The diagnostic importance of scoliosis has been emphasized by Andrus and Holman; they found it in 92 per cent of 50 patients with acute empyema, but in only 10 per cent of patients with pneumonia and in 8 per cent of those with simple pleural effusions. It is their belief that the degree of scoliosis varies directly with the duration of the empyema and inversely with the age of the patient. Inasmuch as the scoliosis can be expected to disappear after drainage of the empyema, if it persists one should suspect an undrained pocket of pus.

In acute empyema the accompanying scoliosis may be convex toward the affected side if the hemithorax is very full of pus. However, the curve of the spine will be concave toward the empyema side when the hemithorax is not very full of pus and when the intercostal muscles are in spasm.

Bisgard has reported 11 cases of severe curvature of the spine which developed in patients with chronic pleuritis; 7 of these patients had empyema. He states that thoracogenic spinal curvatures are pleurogenic or result from thoracoplasty. As a rule, with the onset of empyema a slight lateral deviation of the spine develops with the concavity on the affected side. This results from spasm of the muscles on that side. With early cure the muscles relax and the curvature corrects itself spontaneously. If the disease becomes chronic or is productive of much pleural scar tissue, a spinal deviation occurs with the convexity of the curve projecting into the healthy side, which is the reverse of that caused by thoracoplasty. In this type of pleurogenic scoliosis there is little or no rotation of the vertebral bodies. Hence there is no posterior bulge of the thoracic wall. The mediastinum which is fixed to the spine by scar tissue usually deviates with the spine and this, together with the reduction in the size of the hemithorax and the relative fixation of the lung, leads to reduction of the vital capacity proportional to the deformity. In 102 cases of acute empyema and an equal number of chronic empyema it was found that the younger the individual was the more likely and more extensive the curvature, and, similarly, the more chronic the empyema, the more likely and more extensive the curvature. In scoliosis due to thoracoplasty the scoliosis is rotary and otherwise considerably different from the pleurogenic type. The Schede type of thoracoplasty produced greater imbalance and greater scoliosis than did the extrapleural type. The first objective in the prevention of pleural scoliosis is early and adequate treatment of the empyema. In the postoperative treatment the patient should lie on his side in such a way as to deviate the spine in the direction of overcorrection; this can be accomplished by the use of a soft wedge, such as a rolled pillow placed under the patient's shoulder or axilla. In cases of developed or potential pleural scoliosis the wedge is placed high in the axilla of the diseased side. For infants a plaster bed which maintains the spine in this position of overcorrection can be made. If the curvature persists after the patient has become ambulatory, a corrective plaster jacket should be used.

Chandler believes that scoliosis very rarely persists after drainage of the empyema; he found only 1 case of persistent scoliosis among 280 cases of empyema, the scoliosis in 279 having disappeared after drainage and exercise.

PUTRID EMPYEMA

Neuhof and Hirshfeld have called attention to putrid empyema as a distinct pathological entity. In most cases it is caused by the rupture of a pulmonary abscess into the pleural space. Other causes are putrefaction after intrapleural hemorrhage, necrosis of the lung following infarction or trauma, and pleural invasion from an anaerobic subphrenic abscess. The infection that ensues is due to anaerobic bacilli. Tissue necrosis is a predominant feature; therefore the adhesions, which form early in the infection, may disappear by liquefaction if the anaerobic infection persists. The lining of the cavity is inflamed, hemorrhagic, and sometimes gangrenous.

Neuhof and Hirshfeld have reported 51 cases; of these 25 were due to ruptured acute pulmonary abscess, 16 to ruptured chronic abscess, and 10

followed operations for abscess. They have discussed the diagnosis and treatment of putrid empyema and have emphasized the importance of considering it apart from other types of empyema. They believe that in the acute cases recognition of putrid empyema may be difficult until foul pus is disclosed by aspiration. The onset and course closely resemble pneumonia but the pain is localized and constant. The sputum is scanty or absent and is not blood-streaked. If foul sputum or a foul odor is present, the diagnosis is established. The course may be extremely fulminating. Roentgenograms are of importance, particularly in localizing the fluid. The aspiration of foul pus or foul air is pathognomonic; and following its disclosure, operation should be immediately performed, since nothing is to be gained by delay and since after the aspiration of foul pus there is great possibility of the development of putrid phlegmon of the chest wall. This occurred four times and in each of these 4 cases operation had been deferred after positive aspiration.

Neuhof and Hirshfeld believe that the essential principles of treatment are complete evacuation of the pus, adequate aeration, and adequate care of residual lesions in the lung or pleura. To accomplish these objects wide unroofing which will allow full visualization of the cavity is imperative. Costal resection should be just short of the limits of the lesion in order to avoid entry into the uninvolved portion of the pleural space. The lesion in the lung should be visualized in order that drainage will be maintained to the site of the bronchial fistula and in order that better drainage of the pulmonary abscess may be obtained if necessary. The cavity and all its recesses are then packed with iodoform gauze. (It is probable that zinc peroxide as advocated by Meleney would be of greater value in these anaerobic infections.) Postoperatively, the patient's improvement is dramatic if adequate operation has been performed.

Longacre and Herrmann in producing experimental pulmonary abscesses in dogs found that the incidence of empyema depended upon the overwhelming nature of the infection and the ability of the lung to set up defensive barriers before the necrotic process reached the surface.

Kline and Berger have reported on 55 patients with pulmonary spirochetosis (Miller-Vincent's infection of the lung). Of these, 26 had empyema and 9 of this group died. The authors agree with others who have seriously considered the problem that thoracentesis, if productive of foul pus or foul air, should be followed promptly by rib resection and wide-open drainage. Otherwise the danger of gangrene of the chest wall is great.

Flack has reported 4 cases of empyema accompanying severe pulmonary fusospirochetal infection. Of the 3 patients who had closed intercostal drainage, 2 died. It is unwise to use this type of drainage in putrid empyema since the infection is due to anaerobic or micro-aerophilic organisms; consequently every effort should be made to introduce oxygen into the infected area. Neuhof has pointed out that there is no danger from early open drainage because of the rapid formation of stabilizing adhesions.

Fisher and Abernethy have had similar experience in treating 4 cases of putrid empyema with closed drainage; only 1 patient recovered. In 2 of their cases anaerobic streptococci were found in the pleural fluid.

Dolley and Jones recognize the importance of obtaining prompt and complete evacuation of the pus through a large opening. The operative procedure they have successfully used has been the resection of a long posterolateral segment of the ninth or tenth rib extending anteriorly from the transverse process of the corresponding vertebra. As the diaphragm rises the thoracotomy opening, being diagonal, still maintains completely dependent drainage. Immediately following the opening of the parietal pleura throughout the full length of the resected rib, a very large thick dressing is applied and the patient promptly placed on his back. The weight of the body and the saturation of the dressings prevent ingress of air although drainage is free. After three or four days Penrose drains are placed in the cavity.

The death rate from putrid empyema need not be high if recognition is prompt, diagnosis accurate, and treatment immediate and adequate. If foul pus is aspirated from an empyema cavity, immediate open drainage should be instituted. Rib resection is the method of treatment that has given satisfactory results; all other less radical methods have unreasonably high mortality rates.

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SURGERY OF THE THORAX

TRACHEA, LUNGS, AND PLEURA

Zuckerman, S.: An Experimental Study of Blast Injuries to the Lungs. *Lancet*, 1940, 239: 219.

By blast is meant the compression and suction wave which is set up by the detonation of high explosives.

Mice, rats, guinea pigs, cats, monkeys, and pigeons were exposed, in the open, to blast from the explosion of charges of 70 lb. of high explosive, and from the explosion of hydrogen and oxygen in balloons.

In the high explosive experiments, no animal was ever killed at distances further than 18 feet, and none was ever hurt in any observed way at distances further than 50 feet from the explosion. Almost all the animals between 13 feet (the nearest any animal was placed) and 18 feet were killed; at these distances the positive component of the blast wave (hydrostatic pressure) varied between 126 and 62 lb. per sq. in. In no animal was there any external sign of injury; the outstanding lesion was bilateral traumatic hemorrhage in the lungs, varying in degree according to the distance of the animals from the charge, and the pressure to which the animals were subjected. In all cases in which the degree of injury was sufficient to kill the animal, blood was present in the upper respiratory passage; it was also present in a few cases in which the animals recovered. The lesions were detectable roentgenographically.

The pulmonary lesions caused by blast from balloon explosions were the same in character, and bilateral, except when the animals were placed so close to the balloon that the exposed side shielded the other. In the latter case, the lesions were mainly or entirely unilateral, and confined to the exposed side.

Animals whose bodies were clothed in thick layers of rubber suffered little or no damage compared to the controls.

It is concluded, from these experiments, that it is the pressure component of blast which bruises the lungs, by its impact on the body wall.

SAMUEL KAHN, M.D.

Dean, D. M., Thomas, A. R., and Allison, R. S.: Effects of High-Explosive Blast on the Lungs. *Lancet*, 1940, 239: 224.

A series of 27 patients, who were under treatment for burns or other injuries resulting from the bursting of high explosive bombs at close quarters, is reviewed, with special regard to the state of the chests of these patients. In only 2 cases was the exposure doubtful; in the remainder, severe blast had been experienced.

Only 6 patients complained of symptoms related to the chest, 16 showed some abnormal physical signs, and 14 showed abnormal roentgenograms. Evidence of serious or gross pathological changes in the chest was absent in all but 2 cases; one of these had signs of collapse of a lobe of a lung, the other had signs of a patchy consolidation of the bronchopneumonic type.

It is impossible to assess the relative importance of the three factors to which the patients were exposed—blast, burns, and immersion—in relation to the chest condition. It was difficult to find cases in which there were no external injuries. Immersion may have played an important part in 1 case, but only 3 patients suffered this experience, and 2 showed neither signs nor symptoms of chest involvement. Burns were extensive, though superficial, but in 1 case, with burns which involved almost the whole skin of the chest, there was no x-ray evidence of chest involvement. Physical examination was not possible in this case.

There is a relative disproportion between the chest symptoms complained of and the physical signs found in the cases studied. This may be due to the fact that all of the patients had suffered serious injuries, which would tend to direct their attention away from the chest. Chest complications may arise after explosion blast without definite warning symptoms; routine examinations should, therefore, be performed even in those who are apparently unaffected by the blast.

The common physical signs are: diminished movement of the diaphragm; fullness of the chest, giving it an emphysematous appearance; and impairment of resonance at one or both bases, with or without crepitations. A "blown-up" or ballooned appearance of the chest, especially at the lower costal margins, is frequent. It may be that some true traumatic emphysema results in these cases.

X-rays reveal a diminution of rib expansion, together with a slight loss of translucency, particularly on the left side. This appearance is produced by a slightly thickened pleura, and "bruised pleura" may be the pathological condition present. The reason for the frequent appearance of this condition on the left side is unexplained.

SAMUEL KAHN, M.D.

Ballon, H. C., Guernon, A., and Simon, M. A.: Sulfanilamide and Experimental Tuberculosis in the Guinea Pig. *J. Thoracic Surg.*, 1940, 9: 584.

The authors have reviewed the literature and present a number of experiments to determine the dosage and effect of sulfanilamide upon the course of experimentally induced tuberculosis in the guinea pig. They are of the opinion that sulfanilamide given in proper dosage definitely inhibits the development of artificially induced tuberculosis, but it does not prevent the development of nor cure the tuberculous lesions after they have developed.

JULIAN A. MOORE, M.D.

Samson, P. C.: Indications for Lobectomy and Pneumonectomy in Pulmonary Tuberculosis. *Ann. Surg.*, 1940, 112: 201.

Pulmonary resection as a treatment for certain types of pulmonary tuberculosis is a procedure not in general use, and only 22 cases so treated have been reported in the literature up until August, 1939. The author adds 6 cases of planned lobectomy and pneumonectomy, 3 of each, with a complete discussion and illustrations. He suggests certain criteria and indications for these operations.

It is emphasized that resection is not a substitute for thoracoplasty, but it may be indicated as the only hope of cure for patients in whom thoracoplasty either has been tried unsuccessfully or seems definitely to offer no benefit. Conditions such as advanced bronchial stenosis, which does not respond to attempts at dilatation, with atelectasis of the lung and fibrosis, as well as with retention of secretions and toxemia, are sufficient to indicate pneumonectomy. In these cases the lung is already completely collapsed, postural and other forms of drainage are ineffectual or impossible because of the stenosis of the bronchi, and there is no other way of removing the infected and carnified lung tissue. Lobectomy is indicated in cases in which the process is confined to one lobe and in which atelectasis and toxemia or a large thick-walled cavity cannot be treated adequately by collapse therapy. The position of the lesion also helps to determine the procedure of choice: lesions in the lower lobes are difficult to drain and sometimes adequate treatment by thoracoplasty is impossible. Another indication for resection, advocated by some authors, is the occurrence of repeated severe hemorrhage from a tuberculous cavity. Progressive tracheobronchial ulceration is a contraindication to resection which should be deferred until mucosal healing and fibrostenosis occur.

Operative technique and the hazards of operation are discussed. Of the present series of 6 cases, 4 have either ended in recovery or showed every evidence of a cure. Two terminated fatally following the operation, 1 directly because of a transfusion reaction. In 1 case thoracoplasty had been performed unsuccessfully, and in 5 the resection was preferred as a primary procedure. J. E. Tremaine, M.D.

Crafoord, C., and Linton, P.: The Pedicled Muscle Flap in the Treatment of Bronchial Fistulas. *J. Thoracic Surg.*, 1940, 9: 606.

The authors credit Abrashanoff, a Russian, as being the first to report having closed a bronchial fistula with a pedicled muscle flap. They report having used this method of closing bronchial fistulas on 13 patients with great success.

As a rule the opening of the fistula or residual cavity is enlarged and a pedicled flap of either the pectoral muscles or the latissimus muscle is fashioned large enough and wide enough to fill the cavity completely, so as not to leave any space for secretions to stagnate. It is essential that the blood and nerve supply of the flap be left intact.

Occasionally emphysema results, and occasionally infection intervenes and defeats the operation. The authors advise an attempt at closure after drainage of a pulmonary abscess as soon as the cavity becomes clean and healthy looking. They advise against waiting months for the cavity to contract and close by natural forces.

In their experience with 13 cases, the plastic operation with a pedicled muscle flap has shown itself to be an excellent method of closing residual cavities with bronchial fistulas. Julian A. Moore, M.D.

Campbell, J. A.: Effects of Precipitated Silica and of Iron Oxide on the Incidence of Primary Lung Tumors in Mice. *Brit. M. J.*, 1940, 2: 275.

Statistical evidence seems to indicate that there is a relatively higher incidence of carcinoma of the lung in metal grinders, engineers, and foundry workers.

The author conducted experiments with mice to determine the effects of inhalation of various dusts on the incidence of lung tumors in mice.

He points out that negative results obtained by other workers were due to the use of a strain of mice not very susceptible to tumors and to not allowing the mice to live long enough to develop tumors. Mice, like men, develop cancer in the last quarter of their lives.

Carefully conducted and controlled experiments exposing mice to definite amounts of dust at regular intervals over varying periods of time show that precipitated silica or brown oxide of iron trebles the incidence of primary lung tumors in mice living ten months or longer. The amount of silica used did not cause formation of fibrotic nodules in the lung tissue of the mice, and it is suggested that the fully developed fibrotic nodule of silicosis inhibits malignancy.
Julian A. Moore, M.D.

Hochberg, L. A.: Causes of Failure of Lung Expansion Following Thoracotomy for Acute Postpneumonic Empyema. *Am. J. Roentgenol.*, 1940, 44: 178.

The failure of the lung to expand following surgical drainage of postpneumonic empyema may be due to bronchial obstruction caused by thick mucus in the smaller bronchioles and alveoli. Roentgenographic studies are necessary in the diagnosis.
Harold C. Ochsner, M.D.

HEART AND PERICARDIUM

Piña, P., and Martiarena, L. H.: Wounds of the Heart and Pericardium (Heridas del corazón y del pericardio). *Bol. inst. de clin. quir.*, Univ. de Buenos Aires, 1940, 16: 127.

The authors' study is based on the observations made in 78 cases of wound of the heart and 17 cases of wound of the pericardium treated at the Municipal Hospital of Santiago de Chile from 1911 to 1939. Seventy-two of the wounds of the heart were caused by knife thrusts and 6 by firearms; the right ventricle was injured most frequently, in 33 cases, and the

left ventricle in 29 cases. When a wound of the heart or of the pericardium is suspected, the localization of the cutaneous wound is of the greatest importance; except in 3 cases, it corresponded to the dangerous zone of Zeidler, that is, the site between the right border of the sternum, the left axillary line, and the second and eighth ribs. The diagnosis is certain when the so-called syndrome of wound of the heart is present: the subject is pale, anxious, cyanosed, chilly, and soaked with perspiration; at times he is unconscious and in a state of dyspneic tachycardiac shock; his pulse is very weak and his arterial pressure cannot be verified, or it is so low that the maximum and minimum are close together. This syndrome is also present in wounds of the pericardium when they are followed by hemorrhage. This shows that the syndrome is due to the accumulation of blood in the pericardium and not to the functional changes caused by the wound of the heart. The syndrome is so characteristic that it requires a differential diagnosis if one of its elements is absent or presents itself under a different form; this may occur in penetrating wounds of the chest, whether simple or complicated with wound of the lung, and in wounds of the internal mammary artery.

The only useful treatment is surgical and the technique to be followed will depend on whether there is certainty or only a suspicion of wound of the heart. In the first case, the thoracotomy of Fontan is used and in the second, that of Kocher or Spangaro. The postoperative treatment must include keeping the patient isolated and at absolute rest; eliminating pain; avoiding cardiac tonics and excitomotor drugs, but administering peripheral analeptics, such as adrenaline, camphorated oil, cardiazol, or coramine; avoiding the parenteral administration of fluids without first verifying the arterial pressure; and, finally, administering prontosil or another similar preparation in maximal therapeutic doses as a means of preventing infection, which occurs frequently in these cases.

Complications have arisen in 98.91 per cent of the patients who have been operated upon; in 73.11 per cent there was a hemothorax due to the wound or to the intervention. Its cause is to be found in the neglect of ligation of the intercostal or the internal mammary artery; strict observance of this surgical rule has lately eliminated hemothorax. Infection is another complication; it occurs either in the operative wound (principally because the traumatic wound has been insufficiently treated and has been included in the surgical wound), or in the pleura or the pericardium (25.20 per cent of the operated cases), and it has appeared in patients who died between forty-eight hours and thirty-seven days after the operation. Surgical cleansing of the pleural and pericardial cavities is indicated to avoid it.

Death must be attributed to the complications: hemorrhage and infection. Fourteen of the wounded or 17.94 per cent, have survived; most of them had a wound of the left ventricle. The most exact method for their study is electrocardiography. In accordance with its results, complemented by those of clinical and roentgen examinations, the survivors can be classified in four groups: (1) those who suffered an infarct of the myocardium and improved gradually; (2) those who had the same lesion which persisted electrocardiographically, but who live and are in good condition; (3) 1 patient in whom no cardiac disturbance occurred; and (4) those who had a wound of the auricle, the electrocardiographic characterization of which is not typical and does not quite confirm the operative diagnosis.

Although the symptoms of wound of the pericardium are similar to those of wound of the heart and are also dependent on acute hemopericardium, there were 2 cases in which the symptoms were alarming although they presented hardly any hemorrhage; such facts are hard to interpret. The intervention and the complications are the same as in wounds of the heart. Fifteen of the patients were operated upon and 2 were not: of the former, 11 died, while the latter 2 survived. This gives a survival of 26.66 per cent among the operated patients. In general, the wounds were very grave; in half of the cases, the wound was of the deep thoraco-abdominal type with lesions of the liver, stomach, and spleen.

RICHARD KEMEL, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Shelley, H. J.: Incomplete Indirect Inguinal Hernias; A Study of 2,462 Hernias and 2,337 Hernia Repairs. *Arch. Surg.*, 1940, 41: 747.

A study was made of all hernias in patients admitted to the wards of St. Luke's Hospital, New York, during the period from 1926 to 1935, inclusive. Also included in the study were all hernias repaired during the period from 1916 to 1925, inclusive, which were observed postoperatively for nine months or longer. This gave a total of 4,442 hernias, of which 2,462, or 55.4 per cent, were incomplete indirect inguinal hernias. They made up 67.4 per cent of all inguinal hernias included in the study.

Of these 2,462 hernias, 2,337 were repaired. Among the 1,668 cases which were followed up for nine months or longer (the average follow-up time was thirty-six months), 120 recurrences were found, an incidence of 7.2 per cent. The average time after operation at which these recurrences were first noted was thirty-two and two-tenths months.

From this study it is apparent that, to aid in keeping the recurrence rate low after operative repair of incomplete indirect inguinal hernias, the operations should be performed soon after the appearance of the hernia. This is borne out by the figures which show an absence of recurrence in the first fifteen years of life and a very small recurrence for the next ten years of life, with an increasing rate for the greater ages. Also, when the hernia was permitted to remain sufficiently long for it to become scrotal, the incidence of recurrences increased by 50 per cent, and the mortality rate became five times greater than that when the hernias were smaller.

The question as to whether bilateral hernias should be repaired at one operation or two cannot be answered conclusively. Since the recurrence rate for operations done in two stages was only slightly greater than that for those done in one stage, the conclusion is probably justified that the larger and more difficult bilateral hernias should be repaired in two operations. This statement is made because, in the cases studied, repair in two stages was largely done. Only a slight increase in the recurrence rate was found, although the majority of hernias operated on in two stages were certainly associated with a greater expectation of recurrence than those repaired at one operation.

However, as in deciding upon the length of time a patient should be kept in the hospital after the operation, the economic factor must necessarily be taken into account. The patient's ability to pay for two periods of hospitalization instead of one, and to be away from work for two periods instead of one, should probably be the determining factor, unless both hernias present unusual obstacles to the performance of a satisfactory repair. In this case the repairs should be performed at two operations, preferably with two separate admissions to the hospital.

For those bilateral hernias which must of necessity be repaired at one operation, an extended stay in bed will to a certain degree limit the expected increase in the recurrence rate.

Both incarceration and strangulation increase the expectation of recurrence by from 30 to 100 per cent and give mortality rates eight and eleven times greater, respectively. It is obvious that incomplete indirect inguinal hernias should be operated on early, before either of these complications develops.

Meticulous care should be used in the performance of the operation to prevent wound infection and hematomas, particularly since the former gives a recurrence rate of three times the average for the entire group.

Pulmonary and circulatory complications can be kept at a minimum by careful administration of a properly selected anesthetic, maintenance of passive and active motion of the patient's muscles, and frequent changes of the patient's position in bed postoperatively. Rigid refusal to operate on patients having even the slightest evidence of a common cold will aid materially in the reduction of respiratory complications. These points are all very important, as both the mortality rate and the recurrence rate are increased by respiratory complications. Circulatory complications also increase the mortality.

The type of repair must be chosen for each individual hernia. There are so many factors involved that it would be irrational to conclude that because one type of operation resulted in a low recurrence rate (in a set of figures such as those given in one of the author's tables), this type of repair should be applied to all hernias. These figures justify the statement that adding suture of the rectus muscle or of the anterior sheath of the rectus muscle to any type of repair of an incomplete indirect inguinal hernia is not a satisfactory procedure. Probably transplantation of the cord external to the external oblique aponeurosis does not give as satisfactory results as does the Bassini type of transplantation. However, the possible inclusion of a greater percentage of difficult repairs in this group may have accounted for the increase in the recurrence rate of nearly 50 per cent. The figures obtained would indicate that the Willys-Andrews type of repair is an unnecessary addition to the required operative manipulation, although the number of cases in this group was too small to give definite proof. For the larger hernias, for those in patients with poor structures, and in those in which there is a definite direct weakness, the figures indicate that the use of a fascial suture after the technique of McArthur gives a slightly lower recurrence rate than that observed without its use in a group of hernias in which supposedly a lower recurrence rate is more readily obtained.

In all cases in which the patient's financial circumstances permit, hospitalization for a minimum of sixteen days will be repaid by a decrease in the expected rate of recurrence. In the case of hernias which are large or bilateral, or which present other factors increasing the expectancy of recurrence, a minimum period of three weeks' hospitalization should be provided for. SAMUEL H. KLEIN, M.D.

GASTRO-INTESTINAL TRACT

Holman, C. W., and Sandusky, W. R.: Further Observations on the Diagnosis and Treatment of Gastric Lesions. *Ann. Surg.*, 1940, 112: 339.

This report is based upon a series of 53 patients with ulcer of the stomach and 104 patients with carcinoma of the stomach who were studied thoroughly, operated upon, and then followed up postoperatively.

The results of this study showed that in many instances a correct diagnosis cannot be established by any of the diagnostic measures at present available, and were strong evidence favoring the removal of all gastric lesions, if possible, when surgical therapy is undertaken. Of interest was the fact that all patients with benign ulcer which were studied had an acidity which was normal or higher. The comparative value of various diagnostic procedures showed approximately a 15 per cent error in diagnosis when any one of the diagnostic procedures was used alone. However, when all the accumulated evidence was weighed, the error in diagnosis decreased considerably. The character and duration of the symptoms and age of the patient varied so greatly both in ulcer and cancer that their practical diagnostic value was minimal. Roentgenological examination was not conclusive in 33 of 157 patients with gastric lesions. The surgeon was unable to differentiate between a benign and malignant lesion in 23 of 157 patients even by inspecting and palpating the lesion during the operation.

Since there is considerable possibility of error in diagnosis, the treatment of choice becomes surgical excision. The argument against partial gastric resection is a prohibitive operative mortality. This was not supported by the results obtained in this group of patients. Forty-seven patients had either wide excisions or partial resections with 3 deaths, a mortality of 6.3 per cent.

SAMUEL J. FOGELSON, M.D.

Robinson, S. C., and Brucer, M.: The Body Build of the Male Ulcer Patient. *Am. J. Digest. Dis.*, 1940, 7: 365.

This study was prepared in order to determine whether there is a body habitus characteristic of the ulcer patient. Two hundred and fifty male patients with ulcer were studied and compared with a large control group of 7,478 men.

Measurements were made on the nude subject in both the ulcer and unselected groups. The height was measured to one-tenth of an inch on a specially constructed platform. Chest and abdominal circumferences were measured with a steel tape just above the nipple line and at the umbilicus or maximum protuberance. The weight was recorded on a beam scale. The "raw" measurement of weight does not accurately measure the relative under-weight or obesity of a person. For this reason the "ponderal index," which is weight divided by height, more accurately measures the weight factors in that it establishes a more true normal weight and more quickly shows either the presence or absence of obesity.

The mean ponderal index of the ulcer group was 2.15 ± 0.019, while the unselected group had a mean of 2.31 ± 0.004. Further studies of this type showed that the patient with ulcer was found to differ from the control group in every measurement except height. The patient with ulcer tends to be normal or under-weight, his chest circumference is smaller than that found in the unselected population, his abdominal circumference at the level of the umbilicus also is smaller, and his body build shows him to be of a slender, narrow, or linear type build. There is little tendency toward abdominal protrusion. There is a smaller surface area, and the systolic blood pressure tends to be lower. The diastolic blood pressure shows no significant difference, being only slightly lower in the patient with ulcer than in the unselected group of men.

SAMUEL J. FOGELSON, M.D.

Walters, W.: Cardial Gastric Ulcers; Results of Operation for Apparently Inaccessible Lesions. *Arch. Surg.*, 1940, 41: 542.

As a result of a better understanding of gastric ulcers and their earlier recognition, when the lesion is still small and without the complicating features of hemorrhage, perforation, and obstruction, relief of symptoms and healing of the ulcer have resulted from a medical regimen in more cases recently than many years ago. The only objection to a medical regimen in all such cases is that in some of them the lesion, instead of being a small gastric ulcer, is in reality ulcerating carcinoma.

The incidence of malignant change in gastric ulcer has been stated to be from 10 to 20 per cent. The possibility of healing a large gastric ulcer with a crater 1.5 cm. or larger in diameter by other than surgical methods should be looked on with skepticism, for all such ulcers have a tendency to perforate. Surgical removal relieves the menace of fatal hemorrhage from the lesion, or of an acute perforation which may require emergency procedure for its closure. Of great importance is the removal of a lesion which may be malignant or may become so. The risk of operation for gastric ulcer should not exceed 5 per cent, and it is possible to operate on a large series of patients with gastric ulcer with an average mortality rate of considerably less than 5 per cent.

In experience at the Mayo Clinic the large gastric ulcers are most frequently present along the lesser

curvature of the stomach, or slightly posterior to it. In several of the cases at the clinic the ulcer appeared on roentgenological examination to be located very high on the lesser curvature, and for this reason it was thought that operative removal would be difficult; operation disclosed, however, that perforation of the lesion to the capsule of the pancreas had given an erroneous idea of the amount of stomach between the ulcer and the esophagus. In these cases there was actually much more uninvolved stomach than the roentgenogram indicated. On other occasions, the early division of the gastrohepatic omentum at a very high level assisted in mobilizing the upper part of the stomach so that unusually high lesions could be removed without too great difficulty.

As experience develops, more high gastric lesions will be found to be resectable.

Abbreviated reports of 6 cases were selected, not to demonstrate any special point, but because they illustrated characteristic lesions of the types under consideration.

Seventy-six, or 14 per cent, of the 542 gastric lesions for which operation was performed at the Mayo Clinic during 1938 and 1939 were found to be at or higher than a point midway between the angle of the stomach and the esophagus. In 35 of these 76 cases benign gastric ulcer was present. In 26 of the 35 cases of benign gastric ulcer situated high above the incisura angularis of the stomach partial gastric resection was performed with 1 death. There were 34 cases of carcinoma in which the lesion was situated high above the incisura angularis of the stomach; some form of gastric resection (partial or total gastrectomy) was done in all but 1, with 5 deaths. In 7 cases miscellaneous benign lesions were removed by local excision without mortality.

Frequently the high gastric lesion appeared higher in the roentgenogram than it actually was, because of foreshortening of the stomach proximal to it, caused by perforation of the ulcer onto the pancreas or into the gastrohepatic omentum. In most such cases ample stomach could be found above the lesion for safe partial gastric resection after mobilization of the stomach and its perforating process and by a high ligation of the gastrohepatic omentum.

Partial or subtotal gastrectomy was preferred for the surgical treatment of cardial gastric ulcer. When the condition of the patient did not allow this, excision of the lesion with or without gastro-enterostomy was favored. When the ulcer could not be excised with safety because of its proximity to the esophagus or because of the poor condition of the patient, gastro-enterostomy was preferred, inasmuch as a high incidence of relative achlorhydria and healing occurred after such a procedure. The Kelling-Madlener palliative gastric resection in which the ulcer is not removed has not been utilized by the Mayo Clinic.

The difficulty of differentiating a malignant from a benign ulcerative process in the cardial gastric region by roentgenological examination was emphasized.

Saunders, J. B. deC. M., and Lindner, H. H.: Congenital Anomalies of the Duodenum. *Ann. Surg.*, 1940, 112: 321.

Congenital anomalies of the duodenum are relatively rare but the authors have encountered 3 cases in which there was an opportunity to examine and study them in some detail.

In the first case a newborn male child weighing 7 lb. 10 oz. was delivered spontaneously with marked jaundice. The infant nursed poorly and on the third day vomited large quantities of sour-smelling food. There was a large brownish yellow stool. Vomiting continued from the third to the seventh day. The intensity of the jaundice increased and weight loss was marked. A pre-operative diagnosis of pyloric spasm or stenosis was made. After pre-operative supportive measures, operation was performed. The liver was of normal size. The transverse colon was absent from its usual position below the greater curvature of the stomach, being replaced by coils of small intestine. The colon was found accumulated on the left side, which indicated non-rotation. The pyloric region was obscured by a persistent hepatoduodenal ligament. On division of the peritoneal ligament, the duodenum was found matted together by adhesions in the form of an S-shaped loop and fused with the greater curvature of the stomach below the pylorus. On further dissection, the curvature of the duodenum was restored, as it was found to be unfixed, suspended by a mesoduodenum. A stenotic area, three-quarters of an inch long and reducing the bowel caliber to one-eighth of an inch, involved the proximal segment of the second and distal portion of the first part of the duodenum. On longitudinal incision of this area, a lumen the size of a pencil lead was encountered. The openings of the pancreatic and biliary ducts were not observed. The diameter of the lumen was widened by closure of the incision transversely and the lumen was now judged to be of adequate size. After closure, the child was returned to bed in fairly good condition. The immediate postoperative course was uneventful. However, fifteen days after operation the child died suddenly after a convulsion. Autopsy was refused.

In the second case a female white child of seven and one-half years was brought to the hospital because of frequent and persistent vomiting since one month following birth. The vomiting was projectile in type and followed each feeding. At fifteen months of age the child was diagnosed as suffering from a congenital hypertrophic pyloric stenosis and was operated on with the finding of a wide open gaping pylorus. There were many veil-like adhesions from the gall bladder to the duodenum, a large mesoduodenum, and a uniform collapse of the distal two-thirds of the duodenum and small intestine. A long Meckel's diverticulum was present together with many enlarged mesenteric lymph glands. A diagnosis of tuberculosis of the bowel and mesentery was made. A barium meal was given at the University of California Hospital, and the pre-operative

diagnosis of congenital stenosis of the duodenum was made.

At operation the entire small bowel distal to the ligament of Treitz was collapsed. The stomach was markedly dilated and extended downward into the pelvis. The stomach walls and the second part of the duodenum were dilated and hypertrophied. The cecum had not descended from under the liver and was suspended by a mesentery. On mobilizing the duodenum, a circular band was found to constrict the bowel four inches from the pylorus. An incision made over the point of constriction revealed a diaphragm almost completely occluding the lumen. The diaphragm was completely excised and the bowel closed in the Heineke-Mikulicz manner to prevent stenosis. The child did very well after operation. Vomiting ceased and the weight was normal two years after operation.

In the third case a female child of three weeks was admitted because of a large protruding umbilical mass and projectile vomiting of two weeks' duration. The umbilical mass, first observed at birth, steadily increased in size and became gangrenous. The child was badly emaciated and dehydrated. At operation, the protruding tissue was removed and granulations slowly formed in the area. The laboratory reported the presence of liver tissue in the excised mass. The child died four months later and autopsy was granted. Among other findings there was a marked duodenal anomaly present. The first portion extended horizontally to the right and was then abruptly reflected upon itself, in the form of a "U," to the region behind the pyloric antrum. It next ascended obliquely upward and to the right, making an abrupt flexure behind the liver to extend in a sharp curve downward and to the right and making still another flexure behind the first portion of the duodenum; then it passed horizontally to the left where it terminated in the duodenojejunal flexure.

Spriggs, in 1912, stated that congenital duodenal obstruction is not so very much rarer than imperforate anus as one might expect. The one affection, being so obvious, cannot be missed; the other most certainly is not so constantly in the mind of the practitioner and not so obvious, hence it often is missed. Congenital duodenal obstruction results from the effect of either intrinsic or extrinsic factors. The development of the duodenum, as observed from microscopic sections, is given as a basis for the classification of and the opinions concerning the genesis of these anomalies.

The treatment of congenital duodenal obstruction is essentially surgical and should be instituted at the earliest possible time compatible with the physical condition of the infant. Because of the smallness of the bowel in infancy, surgical procedures are often attended by great surgical difficulty. Multiple constrictions are relatively common. From a technical standpoint, it is important to employ extremely fine silk or linen as a suture material, and to perform the anastomosis with a single anterior and posterior layer to obviate narrowing of the lumen. This technique will reward the user with a higher per cent of successful results. Early surgical diagnosis of the lesion and early surgical intervention are most important. It is perhaps the rarity of congenital obstruction which is responsible for the poor prognosis in the majority of reported cases and also for the relative therapeutic inertia. JOHN W. NUZUM, M.D.

Ward, R.: Appendicitis with Complications. A Reduction in Mortality Due to the Use of Continuous Gastro-Intestinal Decompression. *West. J. Surg., Obst. & Gynec.*, 1940, 48: 469.

Ward has made a statistical study of the cases of acute appendicitis from the wards of the University of California Hospital. During the period from 1913 to 1925 there were 206 patients operated on for acute appendicitis with 12 deaths, a mortality rate of 5.8 per cent. This was before the introduction of gastro-intestinal decompression.

In contrast, during the period from 1925 to 1939, a group of 561 patients were operated on for acute appendicitis with the advantage of decompression of the gastro-intestinal tract by means of the Levine nasal tube. In this group there were 17 deaths, a mortality of only 3 per cent. The writer believes that transduodenal decompression was the most important factor in the lowering of the mortality rate.

In the total series of cases there were 462 patients with simple non-perforated appendicitis. In this group there were 3 deaths, a mortality of 0.65 per cent. There should be no deaths in simple non-perforated appendicitis.

In the group with appendicitis with perforation and localized peritonitis, there were 21 patients who did not have the advantages of decompression. Three of these patients died, which gave a mortality of 14.3 per cent. At the same time there were 41 patients with similar pathology who had surgical decompression along with the operation. Only 2 of these died and the mortality was reduced to 5 per cent.

In a group of 10 patients with perforated appendicitis and diffuse peritonitis there were 4 deaths, a mortality of 40 per cent. In a group of 22 patients with similar pathology receiving decompression, there were 6 deaths, a mortality of 27.2 per cent.

The author has devised a plan of management along the line suggested by the Horsleys'.

Rule I. Operate for appendicitis when the diagnosis of appendicitis is first made or strongly suspected. An exception is made in the presence of a diffuse peritonitis or if the patient is moribund. This patient is to be treated by the immediate institution of intestinal decompression with the nasal tube, the restoration of fluid and of electrolyte balance, and the use of Fowler's position with morphine. He is to be prepared for later operation.

Rule II. Under spinal or local anesthesia, approach the appendix through a gridiron incision located over the suspected site of the appendix. Remove the appendix with the cautery, with continuous

evacuation of pus or serous fluid by suction, and with a minimal disturbance of the surrounding structures. Close the stump by simple ligation or inversion without ligation if the cecal wall is not indurated. Close the abdominal cavity without drainage, unless a well walled-off abscess has been found.

Rule III. Drain the abdominal wall adequately in all infected cases, or pack the wound open with vaseline gauze if contamination is great.

Rule IV. Treat the patient postoperatively by intestinal decompression and do not wait for distention to develop. Give morphine for pain and bowel discomfort. Maintain the fluid and electrolyte balance but withhold food and fluids by mouth until normal peristalsis has returned. Use no artificial stimulants to peristalsis.

A short résumé of the case histories of the 29 patients in this group who died from complications is appended. JOHN W. NUZUM, M.D.

Howard, R. N.: Portal Pyemia Following Acute Appendicitis; A Case of Multiple Liver Abscesses with Recovery. *Australian & New Zealand J. Surg.*, 1940, 10: 31.

The author believes that the successful outcome of a case of portal pyemia with multiple liver abscesses seems worthy of note, since it is generally believed to be a universally fatal condition in the more acute forms. However, an extensive perusal of the literature showed this belief to be incorrect.

The author reports the case of a boy aged seven years who was admitted to St. James Hospital, London, on October 21, 1935, with a sixty-hour history of acute appendicitis. The temperature was 101.4° F. The pulse rate was 116 and the respiration rate 20. The lower abdomen was tender and rigid.

The first operation was done under ether anesthesia on October 21, 1935. Through a muscle-splitting incision, a gangrenous retrocecal appendix was removed. Lower abdominal peritonitis with much purulent fluid was present. A drainage tube was placed in the pelvis through a suprapubic stab wound. The incision was closed with drainage of the subcutaneous tissues. Both drainage tubes were removed in forty-eight hours. Gross infection of the wound developed. The temperature rose to 101° F. at night for the next two weeks. It subsided by lysis during the third week only to rise again and become irregularly remittent and intermittent. There followed a week of normal temperature without clinical improvement. The wounds were now healed. The patient was pallid and listless. The hair began to fall out. Examination revealed tenderness of the upper part of the abdomen.

On December 4, 1935, the patient complained of chilly sensations but the temperature was normal. Three days later the temperature rose to 102° F. and further chills were experienced. At this time physical examination revealed fullness and tenderness in the upper abdomen with dullness to percussion. Breath sounds were diminished at the right base. X-rays revealed uniform elevation of the right half of the diaphragm, with diminished respiratory excursion. A probable right posterior intraperitoneal subphrenic abscess was diagnosed. The leucocyte count was 35,000 per c. mm. The patient's general condition was poor.

The second operation was performed December 26, 1935. Under gas-oxygen anesthesia a transverse muscle-cutting incision was made at the tip of the eleventh rib, and 2 oz. of foul pus were evacuated from the right posterior intraperitoneal space. The liver was enlarged but the surface appeared normal. A drainage tube was placed in the abscess cavity. The temperature dropped following operation but there was no improvement in the patient's condition. The liver enlarged to occupy the upper part of the abdomen. The general condition became desperate and ascites developed. The leucocyte count was now 46,000 per c. mm. X-rays revealed further elevation of the right diaphragm with complete immobility. A diagnosis of suppurative pylephlebitis with intrahepatic abscess formation was made and a third operation decided upon.

On January 17, 1936, the third operation was performed under gas and oxygen anesthesia supplemented by local infiltration with novocaine solution. The subphrenic area was needled through the lower right intercostal spaces posteriorly but no pus was obtained. Two inches of the tenth rib were resected in the scapular line and the pleura was opened in the phrenicocostal sinus. A large amount of serous fluid was evacuated. The diaphragm was sutured to the pleura, incised across its fibers, and the liver exposed. No pus was found. The right lobe of the liver was needled and bile-stained pus was obtained at a depth of 1½ in. A cavity the size of a tennis ball was drained in the right liver lobe. Much bile-stained pus welled out and a rubber drainage tube was inserted into the abscess cavity.

Following this operation the temperature fell and clinical improvement occurred. A complete biliary fistula now developed through the drainage tube. The stools were clay-colored. The fistula persisted after removal of the drainage tube on the seventh day. The patient's bile was collected and fed to him through a Ryle tube. Seven weeks later the fistula closed spontaneously. The liver was very large and ascites was still present.

A fourth operation was performed February 24, 1936, through a right upper paramedian incision. Both right and left liver lobes were needled extensively but no pus was found. The surface of the liver showed many elevated firm masses the size of hazelnuts. These were considered to be inspissated fibrosing old abscesses and were not disturbed. Much clear ascitic fluid escaped from the abdominal incision.

Following this fourth operation, the patient began a steady clinical improvement. The liver became smaller, ascites diminished, and his hair began to grow again. He was discharged on May 16, 1936, or 208 days after admission. When reëxamined four months later, the child was in good health.

Early removal of acutely inflamed appendices will prevent this serious complication. Sulfonamide therapy in some adequate form should be instituted immediately. With regard to late cases, sulfonamide should be given in maximal doses and surgical drainage instituted when necessary and possible.

The prognosis of portal pyemia should be greatly improved by early ligation of the ileocolic vein proximal to the clot. Liver abscess formation, while of serious import, is not necessarily fatal.

JOHN W. NUZUM, M.D.

Stone, H. B.: Surgical Problems in the Treatment of Chronic Ulcerative Colitis. *Arch. Surg.*, 1940, 41: 525.

The author remarks that there are varied opinions on the value of surgery in the treatment of chronic ulcerative colitis. Some clinics give the impression that the surgical intervention is a bad last resort. Other clinics and surgeons advocate the earlier employment of operative treatment. For a long time appendicostomy and cecostomy were advised in order to permit irrigation of the diseased colon from above downward. The failure of this idea has been generally admitted by surgeons experienced in this field. Such operations have been abandoned in favor of complete transverse ileostomy a short distance above the ileocecal valve. The principle of this operation is designed to put the large bowel completely out of function and give it physiological rest. Three results are seen from this operative intervention:

1. The colon may heal completely, and permit safe closure of the ileostomy opening.

2. The ileostomy may result in great improvement in the patient's general condition, but continued evidence of the disease in the large bowel remains. When this has been the result the ileostomy must remain permanent. The process is arrested but not cured. This is the course in the majority of patients.

3. The progress of the disease may not be arrested, and further bleeding, loss of weight, and anemia may occur and require resection of the colon.

The author advised the performance of ileostomy if irreversible pathological changes have taken place. Thus, the operative intervention must be done before the barium roentgen study of the colon shows loss of haustration, stiffening, and shortening.

The disadvantages of ileostomy are the need to care for the fecal discharges, the trouble of providing and wearing dressings or apparatus of some sort, and the disagreeable odor or fear of odor. Also a considerable prolapse of the ileum may occur with protrusion of a long piece of intestine, so that the treatment may be as bad as the disease. In the author's experience, later successful closure is possible only when the ileostomy has been employed early. The author suggests the adoption of the procedure described by Cattell, who draws out the stump of the ileum several centimeters beyond the level of the abdominal skin and fixes it there, so that the stump may be inserted into a rubber bag which can be worn during the day. This avoids soiling and irritation of the skin. The author also presents a new operative procedure, which he says will prevent prolapse of the ileostomy as well as provide a trap for the peristaltic waves. In this procedure the ileum is doubled back on itself for a distance proximal to the stoma. An opening is then made between the two opposing loops, so that one large cavity is produced.

When the colon approach is normal the ileostomy may then be closed. The author uses as a guide for the possible closure of the colostomy, the microscopic appearance of the returns of an enema of 1 liter of physiological solution of sodium chloride. This is centrifuged and the sediment thrown down microscopically. The number of red corpuscles and leucocytes give evidence of the amount of active inflammatory process present in the bowel.

WILLIAM C. BECK, M.D.

Norbury, L. E. C., Ogilvie, W. H., Gabriel, W. B., Hurst, Sir A., and Others: Discussion on the Surgical Treatment of Idiopathic Ulcerative Colitis and Its Sequelæ. *Proc. Roy. Soc. Med.*, Lond., 1940, 33: 637.

Norbury says there is no doubt that a certain percentage of early cases of non-specific ulcerative colon proctitis can be cured or relieved by medical means alone. In a larger number of cases, however, the disease becomes chronic or progresses with greater or lesser rapidity toward death.

Surgical treatment may be divided into: (1) methods employed primarily for purposes of colon irrigation, namely appendicostomy and valvular cecostomy; (2) methods directed to the exclusion of the colon from the passage of feces by means of a terminal ileostomy; and (3) ileostomy followed by colectomy with anastomosis of the ileum to the rectum, or ileostomy followed by excision of the colon and rectum.

The author's experience has been chiefly confined to appendicostomy. Of 27 patients on whom appendicostomy was performed in the past ten years, 4 died from twenty-six days to six months after operation. The general health of the remainder steadily improved, as evidenced by gain in weight and the sigmoidoscopic appearance of the colon. The latter improves more slowly than the general condition of the patient.

High colonic lavage *per rectum* is definitely dangerous in the presence of ulcerative colon proctitis, and does not actually traverse the colon as shown by roentgenograms. With an appendicostomy the patient can irrigate the colon himself.

Appendicostomy can be done expediently under local anesthesia, through a muscle-splitting incision. A well fashioned appendicostomy has no tendency to close spontaneously, but cicatricial contraction can be obviated by regularly passing a catheter.

Two pints of normal saline solution morning and evening are usually used for irrigation of the colon. Warm olive oil can be instilled at night and washed

out in the morning by the saline enema. Irrigations may have to be employed for months or even years in some cases.

Blood transfusion is of great value.

Cecostomy is performed when the appendix is unsuitable for appendicostomy or when it has been previously removed. This may be of the Senn type, as devised for gastrostomy, or after the method of Witzel.

Ileostomy is indicated in severe cases with marked general symptoms of toxemia, abdominal tenderness, and distention; profuse discharge of pus *per rectum*; and extensive ulceration as shown by sigmoidoscopy; also when appendicostomy has failed.

Colectomy appears unnecessary in the early stages and dangerous in the later, according to this author. Appendicostomy is a valuable adjunct to medical treatment.

Ogilvie believes that the surgery of ulcerative colitis is essentially destructive; it is to be used when medicine has failed, and has no place as an adjuvant to medical treatment. Neither appendicostomy nor cecostomy offers better results than medical treatment alone.

Absolute indications for operation include: stricture of the colon, polyposis, and fistulas, particularly in the ischiorectal fossæ.

Presumptive indications for operation include: repeated severe hemorrhage, constant blood loss of lesser degree, continuous bed confinement for a year, a fourth relapse in spite of intervals of reasonable health, and a segmental distribution, particularly if it involves the proximal colon only.

Contraindications to operation consist mainly of the fulminating type of case. Even though an ileostomy is well tolerated under local anesthesia, it does not prevent death from toxic absorption.

The surgical treatment as carried to completion in a small number of cases consists of three stages: exclusion (ileostomy), excision (resection), and restoration (ileosigmoidostomy).

The author has treated 17 cases of ulcerative colitis radically, with 7 deaths. Five patients died after ileostomy; 3 of these had the fulminating type of colitis with a few weeks' history; 1 died of ileus, and the last died of ulceration of the ileum ten weeks after operation. Of the remaining 2, one died after colectomy, and the other from peritonitis following ileosigmoidostomy. The 10 living patients are all in good condition; 8 have permanent ileostomies, and 2 have the ileum re-implanted in the pelvic colon.

Washing out of the colon is unnecessary, for the colon recovers so rapidly that washing out is superfluous and tends rather to favor the absorption of toxins. Thus, a single-barrelled ileostomy is done. The discharge from the ileum is at first continuous and liquid, but the fluid loss is made up by an increased intake and more than compensated for by the rapid disappearance of toxemia. Within two or three weeks the efflux is less liquid, and within three to six months it becomes semi-solid, and is passed at intervals of from three to four hours. Before the efflux becomes solid, irritation of the skin can be prevented by aluminum paste; later only a colostomy belt is necessary.

Gabriel states that according to Lium's experimental colon explants in dogs, spasm may be the chief cause of ulcerative colitis. If his views are correct, we have an added reason for advocating the need of early treatment before prolonged spasm produces irretrievable damage. At this stage medical treatment is of paramount importance.

Surgical treatment is indicated: (1) when in spite of bed rest and careful medical management the patient's condition gets worse, with loss of weight and strength; (2) when there are repeated hemorrhages; (3) when signs of toxemia persist with an evening temperature up to 101° or 102°, a dry tongue, and a rapid pulse, despite medical management; (4) when there are exhaustingly frequent stools; and (5) in the fulminating type of case.

Appendicostomy is the safest, easiest, least mutilating, and most rational surgical treatment, particularly in young subjects, and should be done before the disease has advanced too far.

Of 25 patients treated by appendicostomy, 5 died in the hospital with no relief from symptoms. In 2 of these the condition was very acute. There were 12 very good results with follow-ups ranging from six to nine years. Three cases were improved, but later untraced.

Hurst believes that Lium's theory, that spasm causes ulcerative colitis, is untenable. On the other hand, he states ulcerative colitis, in common with diverticulitis of the colon, frequently gives rise to spasm.

In support of his belief that proper medical management can be very successful, the author shows the results of 85 cases treated medically. These cases received medical treatment from one to twenty years prior to 1937. Of 85 patients, 77.6 per cent were quite well, 10.6 per cent were not well but showed improvement in their conditions, 2.4 per cent were ill, and 9.4 per cent had died.

When ileostomy, the operation of choice, is done, each case must be judged on its merits before a decision is made to keep the opening permanently. Before closure of an ileostomy the bowel is trained for several weeks by the injection of some of the feces discharged from the ileum through the distal ileostomy opening. The feces are first diluted with water, and gradually made stronger, until finally the whole of the ileal contents are injected undiluted. If there is no untoward reaction it is safe to rejoin the divided ileum. If, however, the disease is of long standing and strictures or polyps are known to be present, an ileosigmoidostomy should be performed instead. It is generally unnecessary to excise the excluded part of the colon.

If pus and blood are still being excreted *per anum* one year after the ileostomy, the colon should be excised to about 9 in. from the anus. The remaining colon can then be treated and brought into suitable

condition in order to have the ileum joined to it after a period of several months. If, however, this should not be done, the remaining part of the pelvic colon and rectum can be excised.

Lockhart-Mummery gave his own figures as follows: of 44 patients treated by appendicostomy for ulcerative colitis, 21 were cured, 16 were relieved, and 7 died (4 deaths occurred in children under twelve years of age). Of 4 treated by cecostomy, 1 was cured, 1 was relieved, and 2 died. This author's opinion is that appendicostomy plays a very useful part in the treatment of ulcerative colitis.

Corbett says that although satisfactory results follow appendicostomy for ulcerative colitis, it is possible that some of the patients would have recovered without it. Of the 20 per cent who died, perhaps a considerable proportion might have survived if terminal ileostomy had been done.

A terminal ileostomy is considered better than an ileostomy in continuity, or double-barrelled ileostomy. Corbett protects the skin around the opening by keeping the bowel closed for from twenty-four to forty-eight hours, if possible, inserting a Paul's tube, and protecting the skin with zinc cream or *tulle gras*.

Smyth saw 2 cases of ulcerative colitis in patients under twelve years of age. Cod-liver-oil emulsion cannot be made to reach the cecum satisfactorily when injected into the rectum. Therefore an appendicostomy or cecostomy is of great help in cleaning out the colon.

Patterson reported his experience with 48 cases of ulcerative colitis; 9 of his patients died. Eight had had operations and 1 of these died after colectomy.

Vaizey and Butler reviewed the results of treatment of ulcerative colitis in 89 patients. There were 30 males and 59 females. Nine were under twenty years of age; 47 between twenty and forty; 27 between forty and sixty; and 6 more than sixty years of age. The youngest was eleven, the oldest seventy.

The immediate mortality, up to one year after operation, was 17 per cent. Five more patients died within three years, 2 in from three to ten years, and 4 more than ten years after operation.

Fifty-two patients are known to be alive, 29 of whom were reëxamined. Five were completely well, 8 had relapses from time to time; 8 had chronic diarrhea; 3 had rectal stricture; and 3 were ill and weak. Including reports by mail, only 10 of 81 followed up really had a lasting symptomatic cure.

Of 26 patients operated upon, 16 had appendicostomies, 4 had cecostomies, 3 had colostomies, 2 had ileostomies, and 2 had exploratory laparotomies. The operative mortality was 10 per cent, and there were 16 recoveries. HAROLD LAUFMAN, M.D.

Miller, E. M.: Gangrene of the Sigmoid Flexure of the Colon Due to Volvulus; Recovery of a Child; Spontaneous Anastomosis Between the Descending Colon and the Rectum. *Arch. Surg.*, 1940, 41: 403.

The author reports a case of spontaneous anastomosis between the descending colon and the upper part of the rectum, occurring in a twelve-year-old girl who recovered from complete gangrene of the sigmoid flexure due to volvulus. One of the predisposing causes of volvulus is an abnormally long mesentery combined with a narrow base between the afferent and efferent loops. Contributing factors include the presence of adhesions and tumors in the mesentery or bowel, and constipation.

A diagnosis of ruptured appendix with peritonitis was made, based upon the history of an acute onset twenty-two hours before admission, and the symptoms which consisted of nausea, vomiting, abdominal pain, and fever. Because of dehydration and abdominal distention, fluids were administered and continuous duodenal aspiration was instituted; morphine was given because of discomfort. A roentgenogram revealed a greatly distended loop of large bowel.

When the abdomen was opened through a right rectus incision, foul-smelling, blood-stained fluid escaped. The entire sigmoid flexure was found to be twisted, distended, and gangrenous. The gangrenous loop extended so far into the depth of the left flank that resection would have been impossible even if the patient's condition had permitted it. The gangrenous sigmoid was exteriorized and slowly deflated of gas and fecal contents by means of a large syringe.

Although very little hope for recovery was entertained, the patient rallied after the operation, and the gangrenous bowel was gradually trimmed from day to day. One month later the patient passed a normal stool by rectum and continued to do so each day thereafter, while less fecal material was passed from the abdominal wound.

Six weeks after operation a lateral anastomosis between the descending colon and the rectum was done through a clean left rectus incision, in order to more completely reëstablish the continuity of the bowel. Progress thereafter was very rapid and the patient was finally discharged perfectly well, the original wound having closed completely.

The advisability of being conservative at the initial operative procedure in the presence of such extensive gangrene is emphasized.

HAROLD LAUFMAN, M.D.

David, V. C.: Some Etiological and Pathological Factors in Cancer of the Large Bowel. *Arch. Surg.*, 1940, 41: 257.

Studies on material covering 200 resected cancers of the large bowel and 100 specimens of supposedly benign polyps of the colon and rectum were carried out to call attention to the frequency of occurrence and the histological structure of such tumors.

The incidence of mucous polyps varies and depends upon whether the polyps are discovered as a result of examination of patients complaining of symptoms, or whether they are looked for at necropsy. One of the most common deviations from normal in the mucosa of the colon is the occurrence of flat elevations of the size of a millet seed. These are usually multiple and occur in old persons, perhaps another example of senile hyperplasia of

epithelial surfaces. They may also occur as an inflammatory lesion in colostomy openings or near ulcerating carcinomas of the bowel. Histologically, they are simple hyperplasias with inflammatory reaction.

The type of tumor next in frequency is the adenomatous polyp. It varies in size from that of a pea to that of a large cherry, and may have a sessile attachment or a pedicle. These polyps are transparent or have the same color as the mucosa, in which instance the epithelium is akin to normal and the body of the polyp contains sparse epithelial elements, many of which are cystic. There may be considerable inflammatory infiltration.

Other polyps of this adenomatous group vary almost insensibly from the type described, to polyps which have every evidence of a growth or tumor change in their epithelium. The results of the author's study convinced him that there was a gradual transition of these polypoid growths from hyperplasia to adenoma formation. The most convincing evidence of a malignant tendency of these polyps is the actual carcinomatous change in a lesion, the major part of which is benign from both a gross and a histological viewpoint.

Another type of benign polypoid tumor of the large bowel is the papilloma or villous tumor. These as a rule are large, extending on the average perhaps 2 or 3 in. above the surface of the bowel. These may produce obstruction or serve as the apex of an intussusception, but their most common symptoms are hemorrhage and the excretion of a large amount of mucus. If not removed completely, they will recur locally, even though the recurrence is benign. In 2 of 27 cases an early carcinoma was seen beginning in such a lesion. Malignant changes usually begin in the center of these tumors. They resemble carcinoma grossly more than any other benign polypoid tumor.

Multiple polyposis is another condition presenting strong evidence of a definite relationship between benign polyps and carcinoma. Not infrequently three or four of these may show carcinomatous degeneration, each surrounded by many benign polyps.

The small and large lymph polyps lack carcinomatous tendencies, but grossly resemble other polyps.

That inflammation has some influence on epithelial changes in the large bowel is evidenced by the tumor-like tags occurring at the margins of long-standing amebic ulcers and histologically showing reduplications of the epithelial elements and even typical adenoma formation. These changes are seen mostly at the periphery of the adenoma. In no area of the adenomas examined could invasion be said to have taken place, but if certain fields in these polyps were compared to fields in a proved carcinoma it would be difficult to distinguish between them. This emphasizes anew the importance of examining the whole tumor.

Carcinomatous changes in these lesions can be safely diagnosed only by gross evidence of induration or ulceration and by histological evidence of invasion of the tumor cells into the muscularis mucosa. While many polyps remain benign for years, they cannot be trusted to do so and should be removed thoroughly, locally if benign, and radically if evidence of malignancy exists. The earliest carcinomas the author has seen in the large bowel are ulcerating lesions on polyps from 1 to 2 mm. in size.

HAROLD LAUFMAN, M.D.

Coller, F. A., Kay, E. B., and MacIntyre, R. S.: Regional Lymphatic Metastasis of Carcinoma of the Rectum. *Surgery*, 1940, 8: 294.

A study was made of metastasis from carcinoma of the rectum and rectosigmoid to the regional lymph nodes in 53 specimens, and an average of 68 nodes per operative specimen were isolated and examined microscopically. The lymph nodes were dissected from each specimen after they had been visualized by clearing with the Spalteholtz method as modified by Gilchrist and David. They were charted and the results correlated with various physical attributes of the associated primary lesion.

According to the classic description of the lymphatic spread of carcinoma of the rectum by Miles, three collecting systems are present: the superior, the lateral, and the inferior routes of lymphatic drainage, corresponding to the superior, middle, and inferior hemorrhoidal veins, and classified by Miles as the extramural lymphatics into which the intramural and intermediary systems drain. The intramural lymphatics consist of two freely communicating networks located within the wall: one, the submucosal, and the other, the intermuscular network. The tendency of carcinoma to spread through the submucosal network does not appear to be as common as the tendency to spread by the radial channels into the deeper intermuscular network. The main avenue of dissemination, however, is through the external muscle coat to the intermediary system, which consists of two parts, a subserous network in that portion of the rectum invested with a peritoneal covering, and a lymph sinus, situated between the external muscular coat and the perirectal fat in that part of the rectum beneath the peritoneal reflection. The third lymphatic system, and the one which is most important surgically, is the extramural.

In untreated cases and in those which have recurrences, it is not uncommon to find carcinomatous nodules in the perineum, rectovaginal septum, and ischiorectal fossa. Consequently, operative removal should include wide excision of the perianal skin, ischiorectal adipose tissue, and levator-ani muscles.

In the authors' material, lymph nodes were found at the site of metastases in 64 per cent of the carcinomas of the rectum and 15 per cent showed invasion of the blood vessels. The age of the patient had no important influence on the presence of metastases in the lymph nodes as 70 per cent of the patients less than fifty years of age, and 60 per cent of those more than fifty years had metastases. A comparison of the incidence of metastases in carcinoma of the rectum classified according to the gross char-

acteristics of the carcinoma, such as sessile, excavating, and polypoid, showed that 80.9 per cent of the sessile type had produced metastases; on the other hand, only 33 per cent of the excavating and 53.5 per cent of the polypoid neoplasms had produced metastases. The only lesions causing involvement of the lymph nodes along the lateral zone of spread were those arising between the mucocutaneous junction and a point 3 cm. above it. In no instance was retrograde metastasis found at a significant level below the primary lesion. No relation was found to exist between the size of the tumor and the presence of metastases in the lymph nodes. No correlation was found between the size of the lymph nodes and the presence in them of metastases. If the lesion had infiltrated through the wall of the rectum, the lymph nodes were involved in 90.9 per cent of the cases while those lesions that were still confined to the wall had caused metastases in the lymph nodes in only 43.3 per cent of the cases. As far as could be determined, 28 per cent of the neoplastic lesions developed in polyps and another 41.5 per cent of the specimens had benign polyps present. Neoplasms arising on the anterior wall had the larger percentage of lymph-node metastases.

Involvement of the lymph nodes and operability are not dependent on the duration of symptoms. Surgical procedure should not be based solely on the histological grading of the biopsy specimens.

The prognosis in any case can be made more accurately by an examination of all of the lymph nodes.

In spread of carcinoma along any zone of diffusion the nodes are not necessarily involved in continuity but may be involved at some distance with normal nodes intervening between the primary site and the metastases.

JOSEPH K. NARAT, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Ravdin, I. S.: The Protection of the Liver from Injury. *Surgery*, 1940, 8: 204.

The main reason for the protection against hepatic injury following a high carbohydrate diet is probably the reduction in the lipid content of the liver which results from such a diet. Under certain conditions, such as inanition, the administration of carbohydrate probably also protects the liver by virtue of its protein-sparing action. Thus the protective action of carbohydrate is an indirect one.

The increased susceptibility of the liver of the starved animal is due to its depleted protein stores. The question of protein storage in the body, following the administration of a diet high in protein, is of particular importance if the protection conferred by such a diet is due to the protein *per se*. Whether the protein is stored in the sense that carbohydrate and fat are stored in the liver, or whether it is elaborated into hepatic or other tissue, it serves to protect the cells or replenish a structure which is being attacked.

From the author's data and the reports of others it has been found that a liver high in lipid content and low in readily available protein is maximally susceptible to chloroform, while a liver low in lipid content and high in readily available protein is maximally resistant to injury by this agent.

The presence of a high protein content in the diet makes it possible for considerable amounts of fat to be ingested and still reduce the original lipid concentration in the liver. These experiments point out the fact that diet and total caloric intake are important, for one without the other will not bring about the desired effects. In view of these data the intravenous injection of glucose appears to be inadequate for liver protection. Under the most favorable conditions of such therapy no more than 1,200 calories per day can be supplied and this cannot be continued over long periods. A high carbohydrate and high protein diet will prove to be more efficacious in conditioning the liver to minimal injury than will a high carbohydrate and low protein diet, or the intravenous administration of glucose with little emphasis on the oral intake of food.

The diet should be satisfactory not only from the standpoint of its composition; it should be administered in sufficient amounts to insure an adequate caloric intake. The two factors can be looked upon as acting synergistically. It is not possible to outline the diet, for this must be done after consultation between dietitian and patient. It should consist of approximately 70 per cent carbohydrate, 25 per cent protein, and not more than 5 per cent fat in its caloric composition. From 2,500 to 3,500 calories should be given for several days prior to operation and resumed as soon as possible thereafter. If necessary the orojejunal method of feeding may be carried out. Since the oral route is at this time the only one by which a satisfactory diet of adequate caloric intake can be given, it must remain the method of choice for the present. Only in those instances in which oral feeding is not possible should parenteral feeding be depended upon.

With such a program in the pre-operative and postoperative periods additional liver injury can be prevented, or minimized following anesthesia or operation. In addition, repair can be facilitated during the period of recovery.

MANUEL E. LICHTENSTEIN, M.D.

Berk, J. E.: The Management of Acute Cholecystitis. *Am. J. Digest. Dis.*, 1940, 7: 325.

The management of acute cholecystitis occupies today approximately the same position occupied by the management of acute appendicitis some forty years ago. Opinion, both medical and surgical, is widely split into essentially two schools: one demanding that acute cholecystitis be considered as an intra-abdominal surgical emergency requiring operation as soon as possible; the other contending that in most cases the disease will subside, and that operation should be postponed until the interval or chronic stage after subsidence has occurred.

In an exhaustive review of reports concerning acute cholecystitis, the following complications were found to be present: empyema 20 per cent, gangrene 25 per cent, and perforation 10 per cent. It would appear, therefore, that acute cholecystitis is not the benign condition it is usually considered. Whereas, in the majority of cases the disease tends to subside spontaneously, in a goodly percentage it will not subside, and many patients will develop serious complications.

Because of the inability to forecast the outcome of a given case of cholecystitis, certain surgeons have adopted a so-called "radical" viewpoint. They advocate early surgery in all cases of cholecystitis, and cite the advantages of fewer complications, such as perforation of the gut, abscess formation, and peritonitis; ease of removal of the distended gall bladder; fewer postoperative complications; and shorter hospital stays. Opposed to these views are those of the so-called "conservative" school who claim that the majority of the patients with acute cases will get well; that the mortality rate is greater when operation is performed during the acute stage; and that the technical difficulties of operating on an edematous gall bladder preclude any extensive exploration of the common duct which might be indicated in certain cases, so that many patients will have to submit to another operation.

A careful analysis of the compiled statistics shows that the mortality rate is three times as great in those patients submitting to "early" surgery, as in those seeking "delayed" surgery. The author points out that it is difficult to evaluate properly the terms, "early" and "late." Some authors refer to the time elapsing since the onset of symptoms, and some to the time elapsing since the patient's admission to the hospital. When the mortality statistics are again compared, it is apparent that the mortality is far greater in those cases in which the patient is operated on after a lapse of only six, twelve, or twenty-four hours after the patient is seen. When, however, the mortality is correlated with the duration of symptoms, it is found that it is much lower in cases operated on within forty-eight hours of the onset. It is only a fourth of that of operations carried out more than forty-eight hours after the *onset* of symptoms.

Despite the low mortality of operations carried out within forty-eight hours, there are definite objections, since in a very high percentage, from 48 to 54 per cent in some cases, there is a mistake in diagnosis. Obviously, if every patient on whom the diagnosis of acute cholecystitis is made is subjected to surgery, there will be many patients who have needless operations.

Since it is so difficult to evaluate any 2 cases, each will have to be decided upon its own merits. Those patients with signs of perforation and peritonitis, or with fever, leucocytosis, and a large tender gall bladder suggesting imminent perforation, should usually be operated on promptly. In such cases one will usually have to be content with a cholecystostomy. If the severe symptoms are not present, the patient should be treated conservatively and watched very carefully for signs of impending perforation. If these develop, he should be operated on immediately. If not, he may be watched, gotten into the very best shape for surgery, and have the benefit of all of the essential diagnostic procedures. Then the surgery may be done with the minimum of risk to the patient.

JOHN W. EPTON, M.D.

De Filippi, J.: Stricture of the Common Duct Following Cholecystectomy (Estrechez del colédoco consecutiva a colecistectomía). *Bol. y trab. Acad. argent. de cirug.*, 1940, 24: 702.

A thirty-six-year-old woman was operated on for cholelithiasis. Four years after the cholecystectomy she developed painful crises accompanied by fever. The second operation revealed a fibrous nodule at the junction of the hepatic duct and the stump of the cystic duct. As difficulties were encountered in visualization of the common duct, retrograde catheterization through the duodenum was done and the fibrous nodule was removed. The postoperative course was complicated by a duodenal fistula which closed spontaneously after ten days.

A stricture may follow a cholecystectomy if a stone was present in a diverticulum of the cystic duct, adherent to the hepatic or common duct. A scar or an inflammatory fibrous nodule may develop after dissection of such a dilated cystic duct. If retrograde drainage and the introduction of a retention catheter are impossible, a cholecystogastrostomy or cholecysto-enterostomy may be necessary.

JOSEPH K. NARAT, M.D.

Stewart, H. L., Lieber, M. M., and Morgan, D. R.: Carcinoma of the Extrahepatic Bile Ducts. *Arch. Surg.*, 1940, 41: 662.

A clinical and pathological study of carcinoma of the extrahepatic bile ducts is presented, based on 6 new cases and 98 cases satisfactorily reported in the literature. References to 211 additional cases reported under this title are listed. One case (0.028 per cent) was found in a series of 3,528 autopsies, and 5 cases (0.022 per cent) were found in a series of 22,152 autopsies. The average age of the patients was fifty-nine and three-tenths years. Seventy-three were men, and 31 women. In 3 cases, carcinoma of the hepatic duct occurred in comparatively young persons, aged twenty-nine, thirty-one, and thirty-two years, respectively.

The onset was acute in 88.5 per cent of the cases, and gradual in 11.5 per cent. The principal symptoms and signs, irrespective of the mode of onset, were jaundice, loss of weight and strength, pain, pruritus, anorexia, fever, vomiting, diarrhea, constipation, and nausea. Other less common symptoms were abdominal distention, chills, a sense of weight or pressure in the abdomen, flatulency, and belching. Jaundice occurred in every case, pain was present in 52.9 per cent of the cases, and both jaundice and

pain were associated at the onset in about 10 per cent. Fever, sometimes with chills, occurred in 26 per cent of the cases, usually late. In no instance was a mass in the region of the primary tumor clinically palpable. The liver was palpably enlarged in 68 per cent of the cases, and the gall bladder was enlarged in 26 per cent. The stools were usually clay colored or colorless; they were occasionally fetid, and in 7 cases contained an excess of fat; blood was detected in 9 of 15 stools tested.

A correct provisional pre-operative clinical diagnosis was made in about 20 per cent of the cases. A correct surgical diagnosis was made in 36 per cent of the cases in which celiotomy was done. Roentgen studies were of no direct value in clinical diagnosis.

The primary neoplasm formed a local tumor in 75 per cent of the 35 patients with carcinoma of the hepatic duct. A diffuse growth was present in 25 per cent, with additional characteristics of widespread involvement and a tendency to extend into the liver in a wedge-shaped manner. In 48.5 per cent of the patients extension or metastases occurred to the liver, lymph nodes, pancreas, gastrohepatic ligament, and mediastinum. All the neoplasms were adenocarcinomas. Variability in the size of the gall bladder in the patients with carcinoma of the hepatic duct is to be contrasted with the findings in patients with carcinomatous obstruction at or below the terminal orifice of the cystic duct. In the latter, cholecystic distention occurs unless the gall bladder has been thickened and atrophied by disease.

The neoplasms formed a local tumor growth in 56.3 per cent of the 48 patients with carcinoma of the confluence of the extrahepatic bile ducts, and a diffuse growth in 43.7 per cent. In 45.8 per cent of the patients extension or metastases occurred to the liver, lymph nodes, gall bladder, lung, peritoneum, pancreas, kidney, and spleen. All the neoplasms were glandular carcinomas.

The neoplasms formed a local tumor growth in 57 per cent of the 21 patients with carcinoma of the common bile duct, and a diffuse growth in 43 per cent. In 52.3 per cent of the patients, extension or metastases occurred to the liver, lymph nodes, lungs, and gall bladder. The neoplasms were glandular carcinomas, with 1 exception, which was a squamous-cell carcinoma.

The well known belief that localization of cancer of the bile ducts occurs at points of narrowing of the stream bed seems valid. Gall stones occurred in 20.2 per cent of the patients.

Surgical therapy was instituted in 50 patients. There was an ultimate mortality rate of 98 per cent, the fate of 1 patient remaining unrecorded. The immediate postoperative mortality rate was 68 per cent. JOSEPH K. NARAT, M.D.

Allen, A. W.: The Surgical Management of the Usual Extrahepatic Biliary Lesions. *Surgery*, 1940, 8: 188.

Cholecystectomy from the fundus toward the ducts is a simple and satisfactory procedure. Rarely is there any break in the continuity of the underlying muscular and mucous coats so that the operation progresses in an orderly fashion. The author attempted to trace the type of operation done in every instance of damage to the common duct that has entered the Massachusetts General Hospital, Boston. In only 1 patient in this group was the duct injured when the operation had been carried out from the fundus toward the ducts. This indicates that the procedure is not entirely devoid of danger but that catastrophies are less likely to occur. In the author's clinic at the Massachusetts General Hospital 432 consecutive cholecystectomies were performed during the past four years with 7 deaths, a mortality rate of 1.6 per cent. In the previous five-year period there were 751 cholecystectomies with 22 deaths, a mortality rate of 2.9 per cent. The average mortality rate for the nine years was therefore 2.45 per cent. Explorations of the common duct were carried out in conjunction with cholecystectomy in 35 per cent of the patients operated upon between 1931 and 1939. During the past four years, this figure rose to 44.2 per cent. In the latter group stones were found in the ducts of 20.7 per cent of all the patients operated upon, or in less than one-half of the ducts explored. About 6 per cent more of these patients were found to have an abnormally tight sphincter of Oddi. Thus, it is evident that exploration of the common duct was carried out about twice as often as was necessary.

In a careful study of the records in these cases to ascertain the indications for duct exploration it was difficult to cite many instances in which the procedure was unjustifiable. Stones were removed from a certain number of ducts of normal size or less when the indications were correct. In this series the most reliable symptom of common-duct stone, other than jaundice, was the frequency of attacks. In 60 of 66 patients who had attacks of pain as often as seven or less days apart, stones were found in the ducts. It appears that one cannot depend on the size of the duct as an unmistakable criterion for stone within it. Inasmuch as the mortality rate was elevated to 4.25 per cent when duct exploration was superimposed on cholecystectomy, it was believed that further analysis of this group was indicated. In those patients who had stones removed from the ducts at operation, the mortality was 7.16 per cent, while in those in whom no stones were found the mortality rate was 2.04 per cent. Thus, the careful exploration of the duct itself does not increase the risk, while the pathological processes associated with common-duct stone are significant of a more serious situation.

Perfect exposure of a segment of the supraduodenal portion of the duct must be obtained. Usually, it is wise to free the outer attachments of the duodenum so that this structure can be rolled toward the median line. The duct is aspirated with a fine hypodermic needle, an important precaution regardless of the appearance of the bile withdrawn. When possible, the common duct is opened distal to the cystic duct, but there is great variation in the length

and entrance of this duct into the common duct. One should estimate the size of the duct and make a longitudinal incision in it not longer than the diameter of the duct itself. This wound is best held apart by fine silk guy sutures since these cause less trauma than instruments devised for this purpose. It is wise to culture the bile that escapes from the open duct since subsequent infection, if it should develop, may be more intelligently treated. The escaping bile should be picked up with a suction tip. The author found it of great advantage at this stage of the operation to go to the left side of the patient so that, by placing two fingers of the left hand in the foramen of Winslow, the region of the ducts could be palpated more satisfactorily. The ducts may be irrigated with normal salt solution after the gradual and careful dilatation of the papilla of Vater. The rationale of such a maneuver is based on the frequent findings of a very tight outlet and subsequent symptoms if dilatation has been omitted.

During the five-year period between 1930 and 1935, 395 ducts were explored; of these, 231 had dilatation of the papilla of Vater, while in 164 no dilatation was done. In the next four years 380 ducts were explored and dilatation of the papilla was carried out in all but 50 cases. The operative mortality averaged a little over 1 per cent greater in those patients not having dilatation of the papilla. Eight of the 561 patients having dilatation of the papilla came to secondary operation on the duct at some later period. In 4 of these, stones were again found in the ducts and in 2 the papilla was found to be the same size to which it had been dilated at the first operation. One other patient in this group had four attacks of biliary colic after leaving the hospital but has been symptom-free for a subsequent period of three and one-half years. Among the 214 patients who did not have the papilla dilated, there were 11 secondary operations and stones were found in 9. Ten other patients in this group continued to have symptoms indicative of stone or dyscinesia but they were not reoperated upon in this clinic. Thus, there is this evidence that routine dilatation of the papilla reduces the chance of continued or recurrent symptoms from approximately 10 per cent to less than 2 per cent.

Drainage of an explored duct is wise in all instances because of the difficulty of accurate closure of the incision in the average duct without narrowing it. Also, it provides a safety valve to aid in the control of liver decompression and gives some information regarding the character and quantity of the bile secreted. In routine cases a No. 10 or 12 French whistle-tipped catheter was found to be satisfactory. It should be of live rubber and the suture passing through it should not weaken the tube enough for it to break at the time of removal nor should the suture pass entirely through its lumen. In small ducts it is well to point the end of the tube toward the liver. In large ducts its direction is of less importance but there are some advantages in pointing it toward the duodenum, chiefly because in this direction it may cause a lesser collection of débris in the current of bile and thereby enhance the passage of an overlooked stone. It is well to establish drainage of the most dependent part of this region of the abdominal cavity by means of a cigarette wick or soft rubber tube, regardless of whether or not the common duct has been explored, although by taking great pains one may feel secure in many instances in not leaving a wick through the abdominal wall.

MANUEL E. LICHTENSTEIN, M.D.

Shumacker, H. B., Jr.: Acute Pancreatitis and Diabetes. *Ann. Surg.*, 1940, 112: 177.

A case of severe diabetes mellitus developing in the course of acute hemorrhagic pancreatitis is presented. Other instances of altered carbohydrate metabolism in acute pancreatitis are reported by the author.

The literature concerning changes in the carbohydrate metabolism in acute pancreatitis and diabetes as a complication or sequela is discussed. Glycosuria occurs in about 11 per cent of patients with acute pancreatitis. Hyperglycemia and decreased glucose tolerance occur in a much greater proportion of cases. Glucose tolerance is an important diagnostic test.

Diabetes may develop during acute pancreatitis. It may terminate rapidly in coma, or the patient may survive with a persistent diabetes of greater or less severity. It may ensue after a few months or many years. At least 2 per cent of all patients with severe acute pancreatitis develop diabetes, and from 3 to 10 per cent of those surviving the acute illness develop this malady. A much larger percentage of surviving patients will have milder grades of altered carbohydrate metabolism. It seems unlikely that mild cases of acute pancreatitis would result in diabetes.

It is suggested that these features of acute pancreatitis be kept in mind in the management of this disease, and that systematic follow-up studies be made.

CHARLES BARON, M.D.

Greenlee, D. P., Lloyd, J. G., Bruecken, A. J., and McEllroy, W. S.: Adenoma of the Islets of Langerhans with Hyperinsulinism, Associated with Adenoma of the Thyroid. *Ann. Surg.*, 1940, 112: 378.

The authors present a case of adenoma of the islets of Langerhans with hyperinsulinism, complicated with hyperthyroidism. This case has been thoroughly worked out from a diagnostic standpoint. The patient was a fifty-six year-old white female who had suffered from attacks of unconsciousness for a period of two and one-half years, the attacks coming on most frequently before breakfast. The patient had discovered that the ingestion of food at 3:00 A. M. tended to avert the attacks. She had had a goiter for twenty years, and recently there had been a marked weight loss. Physical examination showed marked emaciation, an adenoma of the thyroid with signs of hyperthyroidism, and a mild hypertension.

Laboratory examinations showed (1) the basal metabolism rate to range from +54 to +65, and (2) the blood sugar to be 34 mgm., 32 mgm., and 57 mgm. Other blood chemistry findings, including calcium, were normal.

It was decided to attack the thyrotoxic state first, since an acute hypoglycemic reaction could be controlled more easily than an acute hyperthyroid reaction. Accordingly, resection of the hyperplastic adenoma of the thyroid was carried out, the patient being given intravenous glucose continuously for the first twenty-four hours; later, glucose was administered intermittently. A marked improvement in general health followed this procedure, and the attacks of unconsciousness became less frequent. Further laboratory studies, including glucose-tolerance tests, were carried out.

Fourteen months after thyroidectomy the pancreas was explored and a tumor 1½ cm. in diameter was resected from the body of the pancreas, near the junction of the body with the tail. Glucose was administered during and after the operation.

Biological assay of the tumor tissue by injection of tumor tissue extract into a rabbit resulted in a marked fall in the blood sugar, with shock and convulsions. Intravenous glucose rapidly improved the condition of the rabbit and resulted in its recovery. A detailed pathological description of the tumor is given.

The patient made an uneventful convalescence, and since the operation, has been free from seizures.

After the detailed presentation of their case, the authors review the various aspects of hyperinsulinism, including the diagnosis, anatomical and surgical considerations, and certain general considerations.

LUTHER H. WOLFF, M.D.

Frantz, V. K.: Tumors of Islet Cells with Hyperinsulinism; Benign, Malignant, and Questionable. *Ann. Surg.*, 1940, 112: 161.

In the literature reporting cases of hypoglycemia with islet-cell tumor, one is struck by the fact that a large proportion of circumscribed tumors which were removed with relief of symptoms could not be designated as being malignant or benign by the pathologist.

In a previous series, Whipple and Frantz reported 8 tumors in 6 patients. No tumor seemed to have any feature suggestive of malignancy, microscopically, other than the lack of complete encapsulation. Since then, however, in their subsequent series, the histological findings in some cases were definitely suggestive of malignancy. Some of these were listed by Whipple in 1938, but without pathological reports.

This article presents these cases with greater detail and analyzes the cases reported in the literature to date (December 31, 1939), as far as it has been possible to find them. Particular reference is made to possible malignant characteristics.

CHARLES BARON, M.D.

MISCELLANEOUS

Ogilvie, W. H.: The Late Complications of Abdominal War Wounds. *Lancet*, 1940, 239: 253.

The late complications that are likely to be met in war wounds of the abdomen are "burst abdomens" and, still later, ventral hernias, residual abscesses, retained foreign bodies, fecal fistulas, and intestinal obstruction. Three differences are present in these wounds which are not commonly present in planned abdominal wounds of ordinary surgery. First, in war wounds, the abdominal parietes are damaged as well as incised. There may be a great deal of damage to the parietes as well as to the contents of the abdomen. Second, the amount of adhesions present is apt to be greatly in excess of any seen in civilian practice. Third, the first operation will probably have been done by some other surgeon in some other hospital than that in which the permanent care is to be attempted. Thus, any type and arrangement of suture may be present.

In the surgery of war wounds, as in the surgery of infection, the best times to operate are very early (under six hours), or very late (after six weeks).

Because of the loss of tissue in many abdominal wounds, they may have to be closed under great tension, and so it is well to relieve tension in every possible way at the time of the first closure. First, a series of tension sutures about ¾ in. apart, with a bite of 1 in. of healthy tissue, is placed. The abdominal wound is then closed with at least two layers of sutures, the deeper taking the peritoneum and the posterior rectus sheath or transversalis muscle, and the superficial one taking the anterior layer of the rectus, or the external oblique muscle. These sutures should be of stout catgut and they should be interrupted. The author has twice employed a piece of canvas well impregnated in vaseline to close a defect that would otherwise have been impossible. The canvas was cut a little smaller than the wound in the abdomen and sutured to the surrounding wound edges. When the sutures came out later, the viscera were covered with healthy granulations and final closure could be effected. Somewhat the same thing can be done in wounds which have already eviscerated. Then, gauze sponges thoroughly impregnated in vaseline are laid on the peritoneum and the wound edges brought as close together as possible. Such vaseline gauze makes an excellent substitute peritoneum, and the coils of intestine can move under it for weeks until the wound edges and contents are fused in an oval of granulation tissue.

The problems presented by ventral hernias are sometimes very difficult. It is sometimes wiser not to do anything rather than to risk any further damage. If the hernial edges cannot be brought within 2 in. by pressure on the sides of the abdomen when the legs are drawn up, it is probably better to discourage the idea of operation. The dissection in such cases must be extremely careful in order that no further damage be incurred. Usually there can be no more than two layers in the repair. In the closure of

such hernias, the use of fascial sutures appears to have a definite place.

Residual abscesses are much commoner in war wounds than in civilian surgery. Here again, it is very wise to treat these cases with watchful expectancy. It is well to wait as long as practicable, for these abscesses have a way of burrowing to the surface or into a hollow organ. Only at the upper and lower ends of the abdomen, in the subdiaphragmatic space and in the pelvis, does the surgeon often have to open an abscess. One should delay as long as possible while keeping an anxious eye on the clinical course of the patient. Here again, the use of vaseline gauze is superior as a drain to anything that we have known before. It drains the entire depth of the abscess, it conforms to the contours of the cavity, and it will never perforate an organ or cause hemorrhage from perforation of a blood vessel.

In the treatment of foreign bodies of the abdomen, the rule of "very early or very late" remains in full effect. All large foreign bodies will have been removed at the first operation or the patient will almost surely have died. The ones remaining will usually be small and they may be lodged in a solid organ, or they migrate to the surface. At any rate, it is wise again to delay operation until the latest possible date. It is not absolutely necessary to remove a foreign body unless it is lying in close proximity to a large vessel, or is responsible for a persistent urinary or fecal fistula that cannot be stopped until it is removed. A transperitoneal approach should not be used if it is possible to avoid it, and the foreign body should be localized through the use of all the means available to that end.

Fecal fistulas are usually not under the care of the surgeon who performed the original operation and usually not much in the way of operative notes will be available. Again the keynote of treatment is patience. A fecal fistula is not doing any harm unless it is leading to loss of nourishment and dehydration, and these do not become serious problems unless the fistula is above the lower third of the ileum, and not always then. When the patient is losing ground, however, waiting can do no good. The fistula may close spontaneously as is its usual tendency. If it does not do so, the longer the period of waiting, the more apt is the tract to become fibrous and better defined. Again, every facility will be employed to give a clear idea of the conditions present. Closure may be effected through local repair or by means of a reconstruction. If reconstruction is the procedure of choice, then the area is carefully dissected, the portion of intestine containing the fistula is resected, and the bowel is closed by end-to-end suture. It is much better to resect a little excess intestine in order to be certain that the anastomosis will be in healthy intestine. In the case of anastomosis of the colon, it is usually wise to provide a proximal safety valve.

Intestinal obstruction is always a difficult condition to deal with. In war wounds it is doubly so, for there have been many opportunities for the soiling and denudation of peritoneum. Moreover, laparotomy cannot be carried out with the same readiness as in civilian practice. An attempt must be made to distinguish between remediable obstruction that will clear up with measures designed to empty and put the bowel at rest, and conditions which require surgery. In the doubtful case one can watch the pulse at hourly intervals, and the abdomen at two-hourly intervals, watching for changes in distention and peristaltic sounds, and for local tenderness and guarding. Our chief aim is to rest the bowel, but there are two others of secondary importance and doubtful attainment—to assist peristalsis, and neutralize toxins.

Rest of the bowel can be accomplished by giving nothing by mouth. Emptying should be carried out above and below. The stomach is best emptied through the use of continuous suction through a Ryle tube. In desperate cases, the Miller-Abbot tube is of great value. Enemas containing 6 oz. of equal parts of water and ox bile produce a tremendous peristaltic action and should be repeated at twelve-hour intervals. Fluids must be kept up through the use of an intravenous drip. A total of 6 pt. of fluids a day should be sought after. This should not contain more than 1 pt. of normal saline solution, and the remainder should consist of 5 per cent glucose in distilled water. In the matter of drugs, morphia is believed to be of value as it increases the irrational, but pitressin acting directly on the muscle seems less open to objection. The author occasionally employs bacillus welchii serum in the intravenous fluids in an attempt to minimize the action of toxins. JOHN W. EPTON, M.D.

GYNECOLOGY

UTERUS

Skinner, I. C., and McDonald, J. R.: Mixed Adenocarcinoma and Squamous-Cell Carcinoma of the Uterus. *Am. J. Obst. & Gynec.*, 1940, 40: 258.

Malignant neoplasms are occasionally found in which there is differentiation into a type of cell entirely foreign to the organ in which it is primary.

Mixed adenocarcinoma and squamous-cell carcinoma of the uterus is a relatively rare tumor. Only 28 proved cases have been seen at the Mayo Clinic in twenty-five years. Eleven of the carcinomas occurred in the body of the uterus, and 17 in the cervix. They constituted approximately 1 per cent of the total number of uterine carcinomas seen during this period.

The greatest number of cases fall in the same age groups as do the ordinary cellular types of carcinoma of the uterus; 70.6 per cent of mixed-cell carcinomas of the cervix and 72.8 per cent of mixed carcinomas of the uterine body occur between the ages of forty and sixty years. The mixed-cell tumors in the uterine body occurred in a slightly older group of patients than did those in the cervix. The symptoms and signs do not differ appreciably from those of the more common varieties of carcinoma found in the uterine fundus and cervix. Eighty-three per cent of the mixed adenocarcinoma and squamous-cell carcinomas of the cervix were graded 3 and 4 according to Broders' classification, whereas 82 per cent of the carcinomas of the uterine body were graded 1 and 2.

In the cervical carcinomas, the adenomatous and squamous elements predominated in approximately an equal number of cases, the squamous elements being in the majority in 9 tumors, and the glandular elements in 8 tumors. On the other hand, in the entire 11 cases of carcinoma of the body of the uterus, the adenomatous elements were predominant.

It is impossible to make a positive assertion concerning the origin of the mixed squamous-cell carcinoma and adenocarcinoma of the uterus. It would appear that the malignant squamous cells in mixed-cell carcinomas of the uterus originate from glandular epithelium without the formation of benign squamous epithelium.

Leissner, H.: Myoma and Carcinoma of the Corpus (Myom und Korpuskarzinom). *Acta obst. et gynec. Scand.*, 1940, 20: 106.

The relative frequency of the simultaneous occurrence of myoma and carcinoma of the corpus uteri has been recognized for many years. The etiological relationship between these two conditions, however, is still a mooted issue. Since the end of the nineteenth century, numerous statistical studies by Winther, Hallauer, Frankl, von Frangue, Gutman, and Robert Meyer, have dealt with this subject. From these studies it appears that 20 per cent of carcinomas of the corpus uteri are associated with myoma whereas only 4 per cent of cervical carcinomas present this association; this is a frequency ratio, therefore, of 5:1.

Recent comprehensive statistical studies of myoma uteri have shown that in 1.8 per cent there was an associated carcinoma of the corpus, and in 2.8 per cent there was an associated carcinoma of the cervix (von Frangue, Schottlaender, Olshausen, and Robert Meyer).

After thoroughly reviewing the statistics in the international literature, the author concludes that carcinoma of the corpus is found at least 5 times as frequently in myomatous uteri as it is in uteri free from myoma.

In an attempt to explain the simultaneous occurrence of these two types of tumors, various etiological possibilities must be considered. Some have assumed that the preëxisting myoma may act as an irritating factor in stimulating degenerative and carcinomatous changes in the mucosa. Others believe that the simultaneous existence of these two types of tumors is merely an expression of the rather unusual tendency of certain uteri to develop tumors.

The author subjected the material presenting itself in the radium department of the University of Stockholm to careful macroscopic and microscopic studies. These studies have shown that carcinoma occurring in myomatous uteri tends to develop in the most inaccessible portions of the organ. The carcinoma never invades the capsule of the myoma nodules, but rather tends to grow around the latter. Because of the inaccessibility of the malignant growth, one may easily fail to detect its presence by means of uterine curettage.

The material studied by the author is too small to admit conclusive solution of the etiological relationship of the two types of tumors discussed. Nevertheless, it may be of value in diagnosis to call attention to the frequency of simultaneous occurrence of carcinoma and myoma, and to point out the unreliability of diagnostic curettage.

HARRY A. SALZMANN, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Numers, C. von: Luteinized Granulosa-Cell Tumor. *Acta. obst. et gynec. Scand.*, 1940, 20: 146.

Lecène, in 1932, described 2 cases of granulosa-cell tumor under the name of "folliculome lipidique." In these, the tumor cells had become luteinized to a very high degree. The tumor parenchyma showed in these cases an obvious morphological correspondence with corpus-luteum tissue. Only a few cases of such tumors have so far been published, whereas even before Lecène several writers described granulosa-cell tumors in which small areas

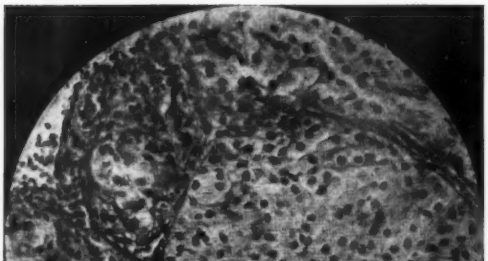

Fig. 1.

of tumor cells having a low content of fat were observed.

The author briefly describes a case of "folliculome lipidique" observed in the Women's Clinic in Helsingfors. The patient, a girl of fifteen, who had not yet begun to menstruate, presented neither virilism nor other signs of hormonal disturbances. A tumor the size of a child's head, originating from the right ovary, was removed; microscopical examination showed that it was mainly composed of large cells resembling corpus-luteum cells, rich in protoplasm, and with a high content of fat (Fig. 1). Isolated

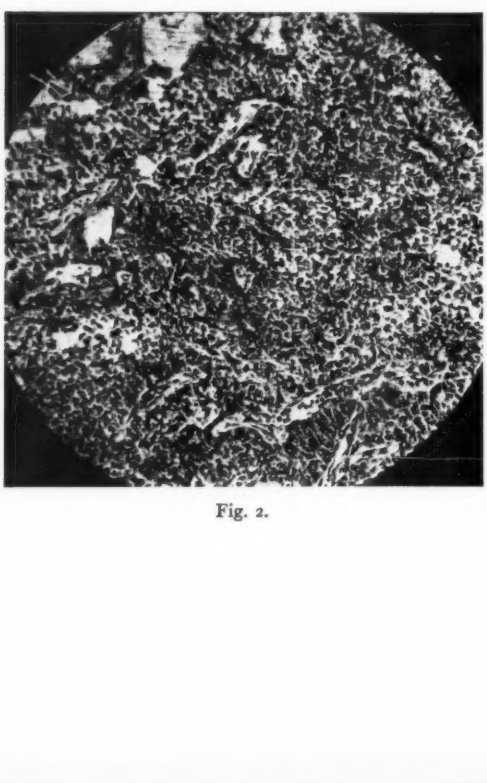

Fig. 2.

smaller areas were found in which no luteinization had taken place; in these areas the histological structure typical of ordinary granulosa-cell tumors could be observed (Fig. 2).

Ovarian tumors earlier described under the name of luteoma or luteinoma were, in all probability, luteinized granulosa-cell tumors. In some cases no hormonal disturbances were observed in relation to these tumors; in other cases virilism, or some disturbance indicating the prolonged influence of corpus-luteum hormone was observed. The tumors classified as primary ovarian hypernephroma are, at least histologically, difficult to distinguish from luteinized granulosa-cell tumors.

Daniel, C.: Malignant Vascular Tumors of the Tubes and the Ovary (Tumeurs vasculaires malignes de la trompe et de l'ovaire). *Gynec. si obst.*, 1940, 13: 93.

Daniel reports 1 case of endothelioma of the right fallopian tube, and 1 case of hemangio-endothelioma of the left ovary. He notes that tumors of this type are very rare in both the tubes and the ovaries. In the first case, the symptoms suggest a ruptured tubal pregnancy with the formation of a pelvic hematocele; at operation a small amount of blood was found in the abdominal cavity and a mass of blood clots in the cul-de-sac of Douglas; the uterus and left adnexa were normal. The right ovary appeared normal but was adherent to the tube, which was enlarged with a tumor mass at the pavilion. The right adnexa were removed. The patient made a good recovery and was free from symptoms a year after operation. Histological examination showed an endothelioma. In the second case, the chief symptoms were pain in the lower abdomen and a palpable mass. At operation a large hemorrhagic cyst was found on the left side; this cyst was intraligamentary and the tube was adherent to its convex side. The right tube was thickened and tortuous, and the right ovary was cystic. A subtotal hysterectomy was done with removal of both adnexa. Histological examination of the hemorrhagic cyst showed it to be a hemangio-endothelioma. The patient made a good recovery, and 15 deep x-ray treatments were given. Eighteen months later she was found to be entirely free from symptoms.

Such vascular tumors of the tubes and ovaries do not produce any typical symptoms; they may simulate chronic inflammation of the adnexa, extrauterine pregnancy, or intraligamentary hemorrhagic cyst. If there is an acute hemorrhage from the tumor, the symptoms are those of ruptured extrauterine pregnancy. The treatment is surgical. There is some difference of opinion as to whether endotheliomas of the tube and ovary are benign or malignant tumors. The author considers that it is best to classify them as being of a low-grade of malignancy, to give postoperative radiation, and to keep the patients under observation for prolonged periods.

ALICE M. MEYERS.

Baron, H. A.: Primary Carcinoma of the Fallopian Tube. *Canadian M. Ass. J.*, 1940, 43: 118.

Baron reports, from the Jewish General Hospital in Montreal, a case of primary carcinoma of the fallopian tube and reviews the 362 cases of this unusual condition found in the medical literature. Kahn and Norris believed primary tubal carcinoma to be one hundred times as rare as carcinoma of the uterus.

The tumor occurs typically in the outer two-thirds of the tube, is usually club-shaped in appearance, and suggests a chronic pelvic infection with unilateral or bilateral pus tubes. Serosal involvement is late, the growth rarely penetrating the tubal wall. Microscopically, three forms of growth, all mucosal in origin, are described: the malignant papilloma, the adenoma, and the alveolar carcinoma. The papillary type is most common. Spread is by way of the lymphatics and usually to remote areas. Pain is encountered early and is due to tubal colic. Diagnosis is difficult but is suggested by the occurrence of pain in the lower abdomen associated with a thin, watery or sanguineous vaginal discharge and enlarged, irregular adnexal masses; uterine changes are absent.

Treatment is by radical operation followed by deep x-ray therapy. Prognosis is very poor, only 7 patients having survived three years without recurrence. Baron's patient with "moderately differentiated adenocarcinoma, probably arising in the Fallopian tube" survived about three months following surgery and x-ray treatment.

WILLARD G. FRENCH, M.D.

MISCELLANEOUS

Petersen, E.: The Results of Surgical Interventions on the Sympathetic Nervous System in Benign Gynecological Diseases (Ueber die Resultate bei Eingriffen in das sympathische Nervensystem bei benignen gynaekologischen Leiden). *Acta obst. et gynec. Scand.*, 1940, 20: 1.

The value of surgical intervention in the sympathetic nervous system as a means of treating benign gynecological diseases is variously estimated. Frequently the results were tabulated too early after the operations. French surgeons are more optimistic about cures than surgeons of other countries. To properly estimate the final outcome of these operations, the number of neurotic patients must be considered. Many neurotics claim immediate benefits, only to return later with the same, or new complaints.

The author reports his own cases treated from 1927 to 1937, and modestly adds the hope that this contribution will aid in judging the permanency of this therapy. He reported on 67 patients. The follow-up periods were from one to eleven years, and averaged from five to six years. Patients who did not return, or could not be traced, were not included in his report. Surgery was never resorted to unless the usual treatment was ineffectual.

There were 53 patients with small ovarian cysts, in all of whom the presacral nerve was resected. Of the remaining patients 7 had dysmenorrhea, 3 vaginismus, 5 chronic parametritis, and 1 pruritus ani. The last was a man and therefore this case does not really belong here. However, since pruritus ani et vulvæ are commonly considered indications for resection of the presacral nerve, the author included this case in his series. It is remarkable that there were no abnormalities of the internal genitalia in any excepting the cases of parametritis. These were "simple cases since neither the uterus, tubes, nor ovaries showed any pathologic changes." In all these cases resection was the only therapy used.

The results were as follows:

Among 7 cases of dysmenorrhea there were 4 with good results; in 1 patient the condition was improved; and in 2 there was no appreciable cessation of pains.

In 1 case of vaginismus the results were good; this patient was cured of dyspareunia, which for years had made coitus impossible. In 2 additional cases of small ovarian cysts complaints of dyspareunia were made, but this was not relieved after nerve resection.

In 1 case of pruritus ani the itching stopped completely, after having existed for years despite all kinds of treatment. After one month the itch returned and after three months it was as bad as ever.

There were 5 cases of parametritis. Following the operation 1 patient was free from pains, now for ten years, and 1 patient was free from pains for seven years. Two patients had definite improvement which lasted to date for seven and five years, respectively; 1 case was unaltered.

Of these 4 groups of patients more than 50 per cent were freed from pains. In 4 cases, including that of pruritus ani, results were negative.

In 30 of the 53 cases of cystic degeneration of the ovaries, the Cotte operation was done, and in 23, the Dupont-L'Hermites denervation of the ovaries was resorted to. In addition to nerve operations, punctures or resections of small ovarian cysts were done in all of these patients.

The value of these combined operations must be judged as rather insignificant, yet the results lasted longer than in the 42 control patients who were not subjected to operations of the nerves; of these 42, none experienced any lasting freedom from pains.

The 30 Cotte operations yielded 9, and the 23 Dupont-L'Hermites, 6 results which were entirely painless. The observations were made up to eleven years after operation.

In the discussion BJOERKENHEIM cited his 14 cases of severe dysmenorrhea. These patients had been treated unsuccessfully by cervical dilatation, curettage, narcotics, or tamponade. In addition to the Cotte operation, Bjoerkenheim followed the Cotte practice of always doing an "antesuspensio uteri," as well as appendectomies and ovarian punctures whenever indicated. Eleven patients experienced complete cessation of pains; on 1 patient, no information could be obtained; 2 experienced no improve-

ment (1 of these was a psychoneurotic who exaggerated her pains to a marked degree). Two married women later became pregnant and labor proceeded normally.

SKAJAA performed the Cotte operation many times. His table includes 106 patients who were operated upon without having any other treatment for pains or for reflex distress emanating from the genital canal. He describes severe essential dysmenorrhea as lasting up to fourteen days and recurring in from one to two weeks. In addition to the premenstrual pains, premenstrual dyspareunia may also be present. Nearly regularly there were distinctly marked reflex symptoms such as nausea, vertigo, headache, depression, migraine, and epileptiform cramps. Some patients are afflicted with constant pains with exacerbations, occurring in different parts of the abdomen: a steady pelvic pressure, a lancinating pain in the iliac fossa, backaches, a sensation of anal pressure and vesical tenesmus, gaseous distention of the abdomen, these symptoms often simulating an "acute abdomen." In a great number of patients psychic trauma or fear brings on attacks.

A constant uterine hypersensitivity is present in these patients, either in the entire organ, the posterior part of the cervix, the sacro-uterine ligaments, or the posterior part of the cul-de-sac of Douglas. The plexus hypogastricus inferior is, according to these localizations, also hypersensitive. Pressing against the promontorium also elicits increased sensitivity of the plexus hypogastricus superior.

Pin punctures and pinching of the skin of parts of the pelvis and lower extremities show hyperalgesic zones in these cases. This syndrome was not known to Skajaa before being described by Cotte as "grande neuralgie pelvienne." Skajaa believes that this is one of the most frequent forms of pelvic diseases in women. Cotte prefers the term "plexalgia hypogastrica" as including all conditions that are indications for his operation.

In conclusion, the results of these operations may take from two months to one-half year to be satisfactory or negative. The close relationship between hyperalgesia and pains is not only of diagnostic and of prognostic importance, but also points to the nature of the malady. MATHIAS J. SEIFERT, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Köster, K. H.: A Roentgenological Study of a Case of Spontaneous Version (Ein Fall von Versio spontanea, verfolgt durch Roentgenuntersuchung). *Acta obst. et gynec. Scand.*, 1940, 20: 59.

The location of pelvic tumors may be such as to cause an absolute hindrance to labor and constitute a positive indication for delivery by cesarean section. Pelvic tumors may also cause deflections or transverse positions. To establish the presence of a suspected abnormal position of the fetus or of a pelvic tumor, x-ray examination is preferable to the usual bimanual examination. Simple A-P plates definitely show important findings without inflicting any deleterious effects upon mother or child.

The author reports the clinical history of a case which demonstrates the value of simple ventrodorsal plates taken during the course of a unique lying-in period. The patient had had two previous normal gestations and gave birth to large babies in cephalic positions. A third gestation period was normal except for a knotty growth in the right iliac fossa, hugging the iliac crest. The patient was never disturbed by this tumor during the one and one-half years of its presence, even though it grew from the size of a walnut to that of a fist during this gestation. Palpation showed this tumor to be hard, fibrous, scarcely movable, not sensitive, and apparently imbedded in the abdominal wall.

In order to establish definitely the diagnosis of a transverse position and to decide whether or not the tumor would influence the position of the fetus, a roentgen plate was made after injecting the bladder with 40 c. cm. of sodium iodide. The child was found to be in a transverse position although the x-ray examination did not demonstrate any trace of the tumor. The position of the fetus continued to remain unaltered. After placing it normally the transverse position would be immediately resumed.

As soon as labor pains began x-ray pictures were taken immediately. They showed the fetus in longitudinal position, the head downward and the back inclined toward the left. Because of this finding it was possible to await a spontaneous delivery calmly. This was of especially great importance since it was impossible to exclude the possibility of the tumor's acting as a hindrance during labor. The child was born in an ordinary vertex presentation.

Spontaneous version occurs so seldom that, in view of the therapeutic possibilities, the presence of a transverse position can hardly be correlated with it. How frequently a version occurs no one knows, as the physician is usually called only when a change to a normal position does not take place, and at this late moment he can hardly afford to wait for such a desired change.

Haussmann defines spontaneous version as follows: "By spontaneous version we understand a course of action by virtue of which a transverse position at the beginning of labor will be changed to a normal position, or vice versa, solely and alone by natural aid, after which change the labor will then proceed along its usual course." These versions may occur in the true or false pelvis, or even in the pelvic outlet. Some authorities, however, insist that the term "spontaneous version" should be limited to those cases in which the change is completed in the true pelvis.

The author completes his article with an exhaustive review of the literature on spontaneous version.

MATHIAS J. SEIFERT, M.D.

LABOR AND ITS COMPLICATIONS

Briquet, R.: Obstetrical Shock (Do choque obstétrico). *An. Fac. de med. de Montevideo*, 1940, 25: 488.

Briquet states that obstetrical shock of the hemorrhagic type occurs in low insertion or premature detachment of the placenta and in abortion; that of traumatic type occurs in sudden emptying of the uterus (twin pregnancy, hydramnios, or large fetus), in prolonged labor, and in surgical delivery; that of neurogenic type is much rarer than the other two and occurs in patients in whom emotional factors and certain constitutional conditions predominate. He accepts as best the definition of shock given by Moon who regards it as a circulatory deficiency which, while not of cardiac or vasomotor origin, is characterized by decrease in the blood volume, lower cardiac output, and higher blood concentration. At present, the most satisfactory classification of shock is that of Blalock who considers three groups: hematogenous, which includes the hemorrhagic and traumatic types, neurogenous, and vasogenous.

Hematogenous shock is always secondary and due to hemorrhage or to traumatism. In hemorrhagic shock, Blalock observed in his experiments on dogs that the cardiac output is decreased, but the blood pressure is affected only when the cardiac output has fallen to 60 per cent or less of its original value; then the hypotension increases gradually. Hemorrhagic shock should not be confused with histamine shock in which the hypotension precedes the decrease in cardiac output and is more pronounced than the latter; in hemorrhagic shock, the mean blood pressure in the presence of reduced cardiac activity is ensured by the compensating vasoconstriction. When the blood pressure decreases to the critical point which, according to Cannon, is from 60 to 70 mm., the vasoconstrictor center ceases to function and vasodilatation supervenes which leads to death; this explains why a late transfusion may not have a

therapeutic effect: the vasomotor center has become incapable of responding to the stimulation.

In traumatic shock, Blalock explains the absence of decrease in the number of red cells by the greater loss of plasma than of red cells with resulting concentration of blood in the injured areas, while in hemorrhagic shock there is a certain dilution of the blood because of the decrease in capillary blood pressure. In traumatic shock, there is a decrease in the cardiac output with temporary preservation of the arterial pressure which falls when the condition becomes worse. In the beginning, the state of shock does not depend on toxins liberated by the traumatized tissues, and the influence of other factors, such as stimuli originating in the traumatized zone, must be admitted. Moon points out that in hematogenous shock the blood volume of the capillaries of the somatic parts of the body is not visibly increased, but there is great congestion of the capillaries and venules of the visceral portions which present a variable degree of edema of the tissues and of effusion in the serous cavities, the fluids having an albumen content nearly equal to that of the blood plasma. In grave shock, the first valuable sign is the blood concentration, which may reach from 6,000,000 to 9,000,000 red cells and is due to blood stasis in the capillary network. This gives rise to a vicious circle: the decreased oxidation favors a fall in temperature which predisposes to capillary atony and increases the viscosity of the blood; transudation of the plasma causes blood concentration and raises the viscosity of the blood, which establishes the vicious circle.

Neurogenous shock is primary and the hypotension is of reflex origin. To this group belong conditions of shock due to abdominal or uterine trauma, disturbances with emotional basis, postural hypotension, syncope of carotid-sinus origin, and accidents of spinal anesthesia. In the beginning, the arterial pressure is decreased; then the cardiac output, but to a slighter degree.

Vasogenous shock is typically produced by histamine, which acts directly on the vessels favoring hypotension; this is followed by reduction in the activity of the heart. Vasogenous shock does not present much obstetrical interest; ergotine may cause it.

Prompt diagnosis is indispensable in order to institute early and correct treatment. The prophylactic measures include physical rest and the administration of fluids, reduction of the duration of the intervention and of manipulations to the strictest minimum, and the avoidance of carbon dioxide in inhalation anesthesia. The curative treatment of hematogenous shock consists of combating the circulatory deficiency and restoring the blood volume. Cardiocinetic and vasoconstricting drugs are useless and there is no proof of a direct action of caffein or strychnine on capillary tonus. Hot coffee and tea have given good results in a number of severe cases. Lowering the head and compressing the abdomen are condemned. Blood transfusion is the treatment of choice; if blood is not available, a solution of gum acacia is used; glucose serum is contraindicated. In neurogenous shock, the treatment consists essentially of placing the patient in the Trendelenburg position and administering ephedrine and other vasoconstricting drugs. RICHARD KEMEL, M.D.

Tamis, A. B., and Klein, M. D.: A Critical Analysis of Cesarean Section in a Large Municipal Hospital. *Am. J. Obst. & Gynec.*, 1940, 40: 250.

An analysis of cesarean sections at Morrisania City Hospital, New York, is presented. The incidence of cesarean section is 0.8 per cent, or 1 in 129 deliveries. The uncorrected cesarean maternal mortality rate is 10.7 per cent. The general uncorrected maternal mortality rate for all deliveries, spontaneous and operative, is 5.3 per thousand living births.

The indications for cesarean section are separately considered, and the errors in judgment and technique are discussed. The superiority of the low segment operation over the classical section is confirmed. The rôle of peritonitis as a cause of maternal mortality following the operation is stressed. The probable causes for this complication at Morrisania City Hospital are enumerated, and the methods whereby its occurrence may be reduced are described.

Two factors, however, have played a prominent rôle in the incidence of peritonitis: (1) the introduction of infection at the operating table, and (2) the type of operation selected. The incidence of wound infections, which, fortunately, consisted mostly of mild stitch abscesses, was close to 20 per cent in spite of the most rigorous precautions in preparing the abdomen for operation. Autopsies on 2 of the 7 patients who succumbed from peritonitis clearly indicated an extension of the infection from the abdominal wound to the general peritoneal cavity.

In checking over the possible sources for this break in technique, the operating room itself came under suspicion. The hospital has two major operating rooms for the use of all surgical cases. As less than 50 per cent of the cesarean sections were elective, not infrequently the operation followed shortly after a potentially or actually infected surgical case. The nursing personnel remained the same for both operations. It is not difficult, therefore, to imagine cross-infection under such circumstances.

The second factor of importance affecting the incidence of peritonitis is related to the type of cesarean operation selected. The classical cesarean section was performed on 70 patients. Six died of peritonitis, a maternal death rate of 8.5 per cent. The low-segment operation was performed 37 times with 1 death from peritonitis, a maternal death rate of 2.7 per cent. The conditions under which the low-segment operation was performed were less favorable than those of the classical group. Nevertheless, notwithstanding this disadvantage, the low-segment operation gave three times more security against the occurrence of peritonitis.

EDWARD L. CORNELL, M.D.

PUERPERIUM AND ITS COMPLICATIONS

García, R.: Puerperal Peritonitis (Peritonitis puerperales). *Bol. soc. chilena de obst. y ginec.*, 1940, 5: 160.

García considers only real puerperal peritonitis which originates through continuity. He bases his study on 44 cases observed at the Maternity Hospital of San Borja and on the reports of various clinics operating in the capital. All show the great preponderance of peritonitis following abortion over that following labor; in his own series, the percentage of the former was 86.4. He discusses the various aspects of puerperal peritonitis and draws the following general conclusions:

In a large proportion of cases (35.1 per cent), peritonitis forms only part of the septic picture. The very frequent involvement of the venous system of the genital apparatus (in 48.6 per cent of the cases) is an additional reason to include a large number of cases of puerperal peritonitis in the group of generalized puerperal infections (sepsis). Induced abortion predisposes to peritonitis in 44.7 per cent of the cases; this occurs especially if instrumental removal of the infected ovular remnants has been attempted. As surgical methods and chemotherapy do not give better prospects for good results in puerperal infection, it becomes necessary, on account of its connection with septic abortion, to avoid as much as possible the occurrence of peritonitis by putting into practice what might well be called the prophylactic treatment, i.e., abstention. In the cases of established septic abortion, particularly when criminal abortive maneuvers have been used, medical treatment should be instituted as the most rational method.

The prognosis of puerperal peritonitis will depend in part on the correct diagnosis and on early intervention. The clinical picture of the disease may vary from that in which the diagnosis is evident to that which might be called silent peritonitis. In the latter, the diagnosis must rest fundamentally on the symptomatic triad of spontaneous pain in the subumbilical region, especially in the vicinity of the uterus; pain induced by mobilization of the uterus during the gynecological examination; and Blumberg's sign, which consists of sensitivity caused by sudden changes of pressure in the abdomen and which Blumberg attributes to the separation of parts of the peritoneal serosa which have been in contact previously. Because of the regularity of its occurrence, Blumberg's sign should always be carefully searched for.

It is better to perform a useless laparotomy or to drain a focus of pelviperitonitis (with the supposed diagnosis of diffuse peritonitis) than to allow the opportune moment for the opening of a puerperal peritonitis to slip by. In any peritonitis, it is advisable to make an examination of the peritoneal pus and to institute blood cultures. Removal of the internal genital organs is indicated only in special cases, in connection with uterine perforation or gangrene, rupture of an adnexal pus pocket, or a badly damaged tube. The frequency of suppurating thrombophlebitis alone makes drainage of the abdominal cavity advisable, as it is practically impossible to extirpate the venous purulent foci. The use of the Mikulicz pack is unnecessary if the intervention is intended only to drain the abdominal cavity; in fact, it prevents the thorough evacuation of the pus in these cases. Concurrently with the surgical intervention, it is necessary to institute an active and opportune general treatment to combat the blood infection. Ileostomy is advised in all cases in which there is great intestinal paralysis. Intervention by the vaginal route may be recommended in appropriate cases; success will depend largely on the experience of the surgeon. Preference should be given to local infiltration anesthesia or to spinal anesthesia if it fills the requirements. RICHARD KEMEL, M.D.

GENITO-URINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Kepler, E. J., and Rynearson, E. H.: Diseases of the Adrenal Glands. *Med. Clin. North Am.*, 1940, 24: 1035.

Acute adrenocortical insufficiency is accompanied by chemical and physical changes in the interstitial fluids, the blood, and, presumably, the cells. Some of these changes are constant and probably fundamental, whereas others are secondary and variable. Among the changes are:

1. Depletion of the body stores of sodium because of increased urinary excretion of sodium. The total base of the extracellular fluid of the body is thereby reduced.

2. Loss of sodium ions in excess of chloride ions.

3. Decreased urinary excretion of potassium and an increase in the potassium content of the blood.

4. Loss of water from the interstitial spaces and later from the blood.

5. Hemoconcentration and reduction in the total volume of blood. The former is manifested by an increase in the concentration of the plasma proteins and the latter by an increase in the percentage of erythrocytes relative to the plasma.

6. Chemical changes in the blood that are usually indicative of renal insufficiency, but without histopathological changes in the kidneys. The concentration of the blood non-protein nitrogen, urea, and sulfates increases.

7. Varying degrees of hypoglycemia and disturbances in the mobilization and storage of glycogen.

8. Decreased utilization of oxygen, hypothermia, and lowering of the basal metabolic rate.

In addition to the potent amorphous extracts, crystalline sterones that have varying degrees of potency in the prevention or rectification of acute adrenocortical insufficiency can be isolated from the adrenal cortex. In chemical structure these substances are closely allied to the purified male and female sex hormones, such as androsterone, testosterone, estrone, estriol, progesterone, and they can be regarded as cortical hormones or as derivatives of a more fundamental cortical hormone.

Acute cortical insufficiency develops either as a result of rapidly destructive lesions of the cortex or following sudden stresses thrown on an individual suffering from chronic adrenocortical insufficiency. Chronic adrenal insufficiency, or Addison's disease, is the end-result of slowly progressing destructive lesions of the adrenal cortex.

The symptoms of acute adrenal insufficiency are anorexia, vomiting, hiccough, epigastric pain, diarrhea, rapid loss of weight, circulatory collapse, and great prostration, and these occur in rapid sequence. Ultimately, delirium, coma, and death ensue. The terminal symptoms may simulate meningitis or other intracranial lesions. The blood pressure is almost invariably reduced, as is the concentration of the plasma sodium chlorides, and total base. Hypoglycemia, increased plasma potassium, and retention of nitrogenous products in the blood may or may not be present.

The symptoms of chronic adrenal insufficiency, or Addison's disease, are, on the other hand, notoriously vague and deceptive in their onset and progress. In some cases fatigue is the only symptom. Weakness, anorexia, pigmentation of the skin, and loss of weight are among the common earlier symptoms. Attacks of epigastric distress and vomiting, and faintness or fainting attacks are not unusual. An inordinate fondness for salt is sometimes noted. Hypotension of some degree is often present, but blood-pressure readings within normal limits are by no means uncommon. The chemical constituents of the blood may be normal in all respects. When patients are not treated, acute cortical insufficiency with its attendant symptoms ultimately appears.

Acute adrenal insufficiency can usually be recognized in cases of known Addison's disease by (1) the characteristic change in the clinical picture which accompanies such a "crisis," (2) studies of the blood chemistry, and (3) the rapid response to specific therapy. The diagnosis in cases in which patients are not known to have Addison's disease may be exceedingly difficult, especially if the pigmentation is minimal or absent.

Three types of procedures to demonstrate chronic adrenocortical insufficiency (compensated) have been devised.

1. The production of acute adrenal insufficiency by restriction of the intake of sodium chloride.

2. Estimation of the concentration of sodium and chloride in the urine after the patient has been kept on a standard regimen in which the intake of sodium chloride has been restricted to a low value and in which the intake of potassium has been kept high.

3. Observation of the effect on the renal excretion of electrolytes following the administration of potent cortical hormone.

The first procedure is decidedly hazardous and may terminate fatally. It should never be carried out unless the physician is thoroughly familiar with the early signs and symptoms of early acute adrenal insufficiency and has facilities for treating it promptly. The test should be terminated immediately if adrenal insufficiency ensues. The second test is less hazardous, but it is by no means free of danger, and not infrequently has to be terminated on the second day because of acute adrenal insufficiency. It likewise should not be used by the inexperienced. The third procedure is accompanied by no risk, but is not generally applicable because of the necessity of carefully conducted balance studies in a metabolic ward and laboratory. To a lesser extent, the same difficulty applies to the second procedure.

Acute adrenal insufficiency usually proves to be fatal unless it is recognized promptly and treated vigorously. It constitutes a medical emergency as grave as diabetic coma. To a large measure, successful treatment depends on early recognition of the condition and on the promptness with which treatment is instituted. Anorexia, hiccough, and vomiting are early danger signals in any patient known to have Addison's disease and nearly always indicate an impending crisis. Infections of any sort usually are significant of serious future difficulties, and for this reason should be regarded with the greatest respect.

At the onset of symptoms most patients will respond quickly to an intravenous injection of 1 liter of a solution containing 9 gm. of sodium chloride, 5 gm. of sodium citrate, 50 gm. of glucose, and from 10 to 20 c.cm. of a potent cortical extract. Patients who have been in a state of crisis for an appreciable time will require more vigorous treatment than the foregoing. Ten cubic centimeters of the extract should be administered intravenously hourly and a liter of the salt-citrate-glucose solution at intervals of six hours. There seems to be very little, if any, danger of administering too much extract. Desoxycorticosterone acetate as dispensed at the present time should not be used in the treatment of a crisis, because this substance is administered intramuscularly in sesame oil and has a relatively slow action. If the patient is completely unconscious the outlook is very grave, and if recovery does take place, residual permanent or semipermanent injury to the central nervous system may be the aftermath. After recovery begins, oral administration of the salt and citrate solution should be substituted for the intravenous injections. About 1 liter should be taken daily. From 10 to 20 c.cm. or more of the extract should be given daily and the amount gradually reduced to the maintenance dosage. If edema appears, the intake of the solution of salt and citrate should be reduced.

There is no unanimity of opinion regarding the maintenance treatment of patients having chronic adrenal insufficiency. Some patients can be maintained in fair health merely by drinking daily a liter of a solution containing 10 gm. of sodium chloride and 5 gm. of sodium citrate, especially if the intake of potassium in the diet is restricted. The cost of treating Addison's disease solely with cortical extract is prohibitive to most patients. The cost of treatment can be kept within reasonable limits by the combined use of cortical extract and the ingestion of extra salt plus sodium citrate. Oral administration of adrenal cortical extract should not be relied on.

Synthetically prepared desoxycorticosterone acetate recently has been made available for general clinical use. Opinions are divided regarding the merits of the compound.

Finally, regardless of the type of therapy decided on, certain adjuncts to the specific treatment are important:

1. The diet should be high in calories and liberal in vitamins. Food should be taken at regular intervals.
2. The potassium content of the diet should be kept relatively constant at a fairly low value, unless desoxycorticosterone acetate is being used.
3. In so far as possible "stresses" of all sorts should be avoided.
4. An effort should be made to avoid the occurrence of infections, and if they occur, intensive treatment with cortical extract should be instituted.
5. Any coexisting tuberculous lesion should be treated.

Hyperfunctioning lesions of the adrenal cortex, such as benign or malignant adenoma, carcinoma, or diffuse bilateral cortical hyperplasia, are capable of producing clinical syndromes characterized by profound changes in the sexual organs and characteristics, and variable, less specific constitutional symptoms. Young adult women are the chief victims. The disease, however, occurs in girls and, occasionally, in boys and men.

Certain variable symptoms occur which are to some extent common to all cases of hyperfunctioning cortical adrenal tumors. These include hypertension, acne, florid complexion, purplish striations of the skin, obesity affecting the face and trunk but sparing the extremities, osteoporosis, latent or frank diabetes, and occasionally, alkalosis with reduced plasma chlorides and potassium. In addition, there may be late symptoms referable to an expanding lesion in one of the upper quadrants of the abdomen.

Cortico-adrenal tumors in boys generally, but not always, result in precocious puberty of the homologous type; that is, puberty is premature but is essentially normal in other respects. In girls these lesions produce precocious puberty of the heterologous type; that is, puberty not only is premature but is more masculine than feminine. The clitoris enlarges, the hair of the body is distributed in masculine fashion, the voice becomes coarse, but the breasts may enlarge and premature menstruation may occur. In children of either sex, dentition may be premature, and the psychic status may correspond to the degree of sexual precocity present.

Cortical tumors in adult males have been known to cause gynecomastia, feminine habitus, disappearance of the beard, loss of libido, and a decrease in the size of the penis and testes.

In most cases cortico-adrenal tumors occur in young women. Amenorrhea and varying degrees of virilism, such as enlargement of the clitoris, atrophy of the breasts, masculine distribution of the hair, and coarse voice, are the chief characteristics.

Unfortunately, the syndromes associated with adrenocortical tumors are by no means pathognomonic. Similar and sometimes identical clinical features occur in connection with the following conditions: (1) basophilic tumors of the pituitary gland; (2) various intracranial diseases not directly involving the pituitary body, such as pinealomas, internal hydrocephalus, and inflammatory lesions; (3) hyperfunctioning gonadal tumors, such as arrhenoblas-

tomas and interstitial-cell tumors of the testis; and (4) other diseases already mentioned associated with cortical hyperplasia. In addition, there is a large group of women with varying degrees of hirsutism, menstrual disturbances, and obesity who have no organic lesions of the adrenal glands. These women appear normal in all other respects.

In spite of the obvious difficulties involved, it is important that a conscientious effort be made to establish a diagnosis, since not only do the symptoms of adrenal cortical tumor promptly regress after the tumor has been removed, but death from metastasis usually is the result if extirpation of the tumor is not undertaken. The following factors aid in diagnosis: (1) intravenous urography occasionally will show evidence of a large adrenal tumor, (2) smaller adrenal tumors sometimes can be visualized roentgenographically after air has been injected into the perirenal tissue spaces, (3) in some instances of adrenocortical carcinoma large amounts of estrogenic substances can be found in the urine (the results of the usual urinary tests based on the content of gonadotropic hormone of pregnancy will be negative), (4) the urine can be assayed for excess content of androgenic substances, and (5) in some doubtful instances it may be necessary to visualize the adrenal glands by surgical exploration in order to affirm or deny the presence of an adrenal tumor.

The treatment of adrenocortical tumors is surgical. After removal of such tumors, failure of the remaining gland (which is often atrophic) can be expected and should be anticipated. Consequently, for one or two days before, and for from seven to ten days after operation, such patients should be treated as if they had Addison's disease. This treatment should be continued after the need for it is no longer apparent and then it should be gradually discontinued. If at operation no tumor is found and if the adrenal glands are definitely hyperplastic, unilateral adrenalectomy or partial bilateral resection may be considered. Experience with such surgical procedures has not been sufficiently great to justify unqualified recommendation of them at present.

Diseases of the adrenal medulla occur less frequently than those of the cortex. Hypermedullary adrenalism resulting from hyperfunctioning medullary tumors or allied tumors of the chromophil tissue has been established as a definite clinical entity.

The chief symptoms are vasomotor attacks, tachycardia, and paroxysmal hypertension, nausea, vomiting, and tremor. Glycosuria and elevation of the basal metabolic rate may be present. In rare instances, hypertension may be continuous. Contrary to what might be expected, sweating may occur during the crises. Sudden death, especially from minor surgical procedures, is not uncommon.

The diagnosis is often difficult, especially if the patient is not under observation during an attack or if the hypertension is relatively continuous rather than paroxysmal. The repeated occurrence of paroxysms of hypertension justifies a tentative diagnosis of this condition.

Treatment is surgical and, if the tumor can be removed, it results in cure.

Ask-Upmark, E.: On Amyloidosis Induced by Tumors of the Kidney. *Acta med. Scand.*, 1940, 104: 512.

The clinical pathology of amyloidosis is briefly reviewed. Two main categories may be distinguished: primary amyloidosis and secondary amyloidosis. The amyloidosis in connection with multiple myeloma will, in certain respects, represent a transitional type.

Two cases of secondary amyloidosis induced by Grawitz tumors of the kidney are described. Earlier observations along this line are recollected and a survey is given of the material available.

From the pathogenetic point of view it seems reasonable to connect the evolution of amyloidosis induced by renal tumors with the long-continued course of these growths, and the likelihood of their interference with the biological response mechanisms of the body, as evidenced by the high sedimentation rate and the frequent occurrence of pyrexia.

The diagnostic importance is stressed. When confronted with amyloidosis of apparently obscure origin, the possibility of an underlying renal neoplasm should always be considered. If, on the other hand, a tumor of the kidney has been diagnosed, the contemporary occurrence of such a symptom as hepatomegaly does not necessarily indicate the existence of metastatic deposits, since amyloidosis may be present.

With regard to therapy, it should be observed (1) that amyloidosis may be induced by renal tumors even if no metastatic deposits have as yet been established, and (2) that the process of amyloidosis is reversible if the condition responsible is removed.

A brief survey is given of the nephrotic syndromes and their relation to surgery.

GENITAL ORGANS

Pool, T. L., Cook, E. N., and Kepler, E. J.: Endocrine Therapy of Cryptorchidism, Impotence, and Prostatic Obstruction. *Med. Clin. North Am.*, 1940, 24: 1057.

The non-surgical treatment of cryptorchidism is a recent innovation and almost wholly endocrine in character. The chief substances that have been used are (1) the anterior pituitary-like principle (A.P.L.), which occurs in the urine during pregnancy; (2) extracts of the anterior lobe of the pituitary body itself; (3) pregnant mare's serum; and (4) testosterone propionate.

The indications for the use of anterior pituitary-like substance in cases of cryptorchidism have not been established definitely to everyone's satisfaction and the results of this form of therapy are decidedly uncertain.

The use of almost any of these substances may be of considerable value in the pre-operative and post-operative surgical treatment of this condition, be-

cause of the growth-stimulating action on the structure with which the surgeon has to work.

In cases of true eunuchism, vigorous replacement therapy with testosterone propionate is unquestionably worth a thorough trial as in a number of instances good results have been obtained. Unfortunately replacement therapy for this condition is exceedingly expensive. Likewise in cases of true male hypogenitalism, endocrine therapy is indicated if there are reasonable indications that spontaneous development is not likely to occur. One of the major problems is the differentiation of hypogenitalism secondary to insufficiency of the anterior lobe of the pituitary gland from primary hypogonadism. In the former, stimulation therapy is indicated and in the latter replacement therapy is the treatment of choice. In many instances this differentiation unfortunately cannot be made. Both types of therapy have been employed with a certain amount of success. Either type of therapy is likely to fail in cases of long standing.

The indications for the use of either testosterone propionate or gonadotropic substances in the treatment of any condition that is characterized by impotence are few. Unlike the ovaries, testes can be inspected and palpated easily. If on examination they seem to be normal and if there are no other objective signs of testicular insufficiency, such as feminine appearance, lack of beard, and the other well known stigmata, it is safe to assume that their hormonal function is probably not impaired, and that neither stimulating nor replacement therapy is likely to be of any value.

Perhaps in the future men suffering from obstruction at the vesical neck may be relieved by some form of endocrine therapy. At present, the great majority will have to submit to operation.

MISCELLANEOUS

MacNeill, A. E., and Bowler, J. P.: Irrigation and Tidal Drainage. *New England J. Med.*, 1940, 223: 128.

This paper describes modifications of a previously described tidal drainage apparatus, resulting in an instrument of wide urological application.

The apparatus described accomplishes: first, intermittent bladder drainage and filling, or tidal drainage; second, tidal drainage, with succeeding irrigation; and third, automatic internal bladder irrigation.

JOHN A. LOEF, M.D.

Mahoney, J. F., Wolcott, R. R., and Van Slyke, C. J.: Sulfamethylthiazole and Sulfathiazole Therapy of Gonococcal Infections. *Am. J. Syph., Gonor. & Ven. Dis.*, 1940, 24: 613.

In an attempt to determine the efficacy of sulfamethylthiazole and sulfathiazole in the treatment of gonococcal infections, the authors obtained a 92.1 per cent cure rate in patients who had not received previous chemotherapy and a 53.8 per cent cure rate in patients who had failed to obtain cure from the previous administration of sulfanilamide. Because of the high incidence of findings which might be construed as evidence of mild attacks of toxic peripheral neuritis, the use of sulfamethylthiazole in the treatment of gonococcal infections is not recommended.

A preliminary report on the use of sulfathiazole with a cure rate of 91.1 per cent in both treated and untreated cases of gonococcal infections, and absence of evidence of toxicity led the authors to infer that sulfathiazole constitutes an effective addition to the treatment of gonorrhea.

D. E. MURRAY, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Jaffe, H. L., and Lichtenstein, L.: Osteoid-Osteoma; Further Experience with This Benign Tumor of Bone, with Special Reference to Cases Showing the Lesion in Relation to Shaft Cortices and Commonly Misclassified as Instances of Sclerosing Non-Suppurative Osteomyelitis or Cortical-Bone Abscess. *J. Bone & Joint Surg.*, 1940, 22: 645.

Under the heading of "osteoid-osteoma," Jaffe in 1935 called attention to a benign bone tumor which had apparently not been described previously, and presented a series of 6 cases. The present communication is based on further experience with this lesion, the authors having now observed 33 cases.

Osteoid-osteoma is a small, slowly growing neoplasm which may develop in spongy or cortical bone. It starts as a proliferation of the local bone-forming mesenchyme and particularly of its osteoblasts. As the lesion develops, considerable amount of osteoid tissue is deposited between the osteoblasts. Later the osteoid tissue becomes slowly calcified, being converted into atypical hypercalcified bone.

Immediately surrounding the tumor and apparently in response to the irritation caused by the slow, torpid growth of the lesion, an area of perifocal sclerosis is formed which may be small in size if the tumor begins in spongy bone, but which may be particularly striking if the neoplasm involves a shaft cortex. There is no evidence of an inflammatory process at any stage of the evolution of this tumor.

The disorder appears to have a predilection for adolescents and young adults chiefly between the ages of ten and twenty-five years. It has been observed in all parts of the skeleton except the ribs, pelvis, and skull. Trauma is apparently not an important etiological factor. The presenting symptom is localized pain, usually of several months' duration, which may be persistent and severe enough to wake the patient at night. There is usually some local tenderness and swelling. Signs of inflammation such as chills, fever, and local warmth are completely absent.

The roentgenographic picture affords the chief diagnostic evidence, but is very likely to be misinterpreted unless the condition is kept in mind. Further, one must remember that the picture has two aspects: that of the osteoid-osteoma proper and that of the perifocal reaction. The tumor itself usually is visualized as a small rarefied area, although, if it has become sufficiently ossified, it appears as a relatively radiopaque nidus. The osteoid-osteoma is surrounded by an area of rather marked osteosclerosis.

Surgical excision of the lesion and some of the surrounding bone has resulted in prompt clinical cure. No recurrences have been observed in seven years of experience with the lesion.

This condition has commonly been misclassified as sclerosing non-suppurative osteomyelitis or cortical-bone abscess. In a clear and logical discussion, the authors present their reasons for classifying osteoid-osteoma as a benign bone neoplasm and considering it as a distinct clinical entity.

DANIEL H. LEVINTHAL, M.D.

Muscolo, D. T.: Giant-Cell Bone Tumors (Tumores oseos a celulas gigantes). *Rev. de ortop. y traumatol.*, 1940, 9: 301.

After a historical review and a lengthy description of the cause, pathogenesis, and macroscopic anatomy of giant-cell tumors and a description of the histological findings, the author discusses their symptomatology, evolution, prognosis, and treatment and arrives at the conclusion that one important question has not yet been answered: Is the lesion of an inflammatory or neoplastic character? Or is the process essentially benign or susceptible to malignant degeneration? Results of endocrinological studies are suggestive of alterations in the parathyroid glands. The author accepts Ewing's classification of giant-cell tumors, viz.: (1) benign, essentially inflammatory tumors; (2) benign tumors with a tendency toward progressive development; (3) tumors with an aggressive character and (4) primary atypical formations, with large fusiform or giant cells.

Experience shows that surgical treatment is most efficient. Ten case histories are furnished.

JOSEPH K. NARAT, M.D.

De, M. N., and Tribedi, B. P.: Skeletal Muscle Tissue Tumor. *Brit. J. Surg.*, 1940, 28: 17.

It is difficult to diagnose a tumor of voluntary muscle tissue from a cellular picture of highly anaplastic stages alone, such as round cells or spindle cells; but whenever there is any suspicion, a sufficient number of blocks from different areas should be carefully studied for the possibility of discovering a striated element, which should finally clinch the diagnosis of a rhabdomyoma.

In the authors' series a number of cases were previously reported as mixed-cell sarcoma and fibrosarcoma, but study of further material revealed the presence of undifferentiated striated element in the tumor mass, which depicted the true nature of these tumors.

In the present series of 14 cases the following are the cellular types that were found: 3 cases of pure myoblastoma, 2 cases of transitional types, 7 cases of rhabdomyoma sarcomatodes, and 2 cases of simple rhabdomyoma. All the patients were of adult age except 3, aged eight, eleven and thirteen years, respectively. There were 6 cases in females and 8

cases in males. Only 2 patients had a definite history of trauma. The tumors occurred in the following situations: face, 2; thigh, 2; arm, 2; axilla, 2; knee, 1; breast, 1; labia majora, 1; tongue, 1; nasopharynx, 1; and leg, 1. JOSEPH K. NARAT, M.D.

Gordon-Taylor, G.: On Sarcoma of the Muscles and the Connective-Tissue Spaces of the Limbs. *Brit. J. Surg.*, 1940, 28: 1.

Sarcoma of the muscles and the connective-tissue spaces of the limbs is an uncommon condition, and is far less frequent than skeletal sarcoma. Every age is liable to the development of these tumors; there is no special liability of any decade. There is also no difference in the sex incidence.

Various types of muscle and connective-tissue sarcomas are illustrated, including rhabdomyosarcoma, fibroblastic sarcoma, spindle-cell sarcoma, myosarcoma, and cavernous angioma.

These tumors are, for the most part, highly malignant. All tumors of the muscles or connective-tissue planes of the limbs should be suspected of malignancy and removed widely at the earliest moment. A histological diagnosis will thus be attained at a stage of the malignant tumor when surgery or radiosurgery has a brighter prospect of effecting a cure than usually obtains. On the other hand, if it be granted that on occasion malignant change in a benign tumor may occur, the removal of an innocent neoplasm is to be regarded as a prophylactic procedure of value, whereby a sinister transformation may have been avoided.

A histological diagnosis is of paramount importance as a guide to the treatment of the sarcomas of the muscles and connective-tissue spaces of the extremity; information is thereby vouchsafed as to whether the methods of irradiation therapy are worth a trial, and as to what type of surgery is required. Whatever be the opinion entertained as to the dangers of a biopsy, this class of tumor is one in which the therapeutic value of exact histological data more than counterbalances the potential risks incurred by the patient in the acquisition of the information.

In regard to tumors of small or moderate dimensions, histological information and a cure may both be obtained by an adequate excision of the new growth, the scalpel being carried through healthy tissues far wide of the tumor. In the event of the malignancy of the neoplasm being attested by means of immediate microscopical investigations, radium may be left in the wound after ablation of the tumor. The experience of Stanford Cade furnishes indisputable evidence of the value of the employment of radium in this way. The utility of postoperative irradiation seems still *sub judice*.

If the tumor is demonstrably confined to one muscle or even a group of muscles, the complete removal of that muscle or the muscle mass is indicated. If the neoplasm proves to be a rhabdomyosarcoma, amputation is probably best, for the results of less heroic measures are appalling; on the other hand, if the growth belongs to one of the other varieties of sarcoma, surgical excision, radium, or radiosurgery may suffice.

If the tumor is of such a size that an attempt to remove it would obviously involve a mutilating operation or would engender grave doubts of its really effective extirpation, a biopsy must be performed by incision of the tumor. It is perhaps desirable that such a biopsy be preceded by radiation (Radiumhemmet). When the tumor proves to be of a radiosensitive variety, irradiation may be tried; if of a radioresistant type, amputation at an appropriate site should be performed.

In amputation at the hip-joint and shoulder-joint it is important that the muscles be cut short. Forequarter amputations are devoid of operative mortality in competent hands, and the fatality of the hindquarter amputation is not too grievous when one recalls the prospects of a patient with a high sarcoma of the lower limb; results seem to justify the performance of the operation.

In the case of a recurrent tumor a wise discrimination must be employed with regard to the advisability of further conservatism or amputation. In a case of repeated recurrence amputation is to be counselled before it is too late.

The frequent history of repeated local operation and the end-results of conservatism suggest the propriety of more drastic surgery, especially amputation of the limb at an earlier date than has been customary heretofore.

Except in the case of obvious lipomas, the operation of enucleation should be barred, however enticing this procedure may be by reason of its simplicity. The capsule in cases of sarcoma of the limbs is a spurious structure, and microscopical evidence of the presence of islets of malignant cells outside the capsule has often been demonstrated.

The prognosis is best in those cases in which the initial stages of development have been latent or tardy; the cases in which the beginning is rapid continue to run the most hurricane course.

The curious fact that unoperated or untreated sarcomas die without evidence of metastases should not stay the hand of those called upon to treat. The life history of such untreated cases is usually only a few years, whereas cures of twenty years and more have been attained by surgery.

This paper may afford some guide to the geographical habitat of the more characteristic specimens illustrating sarcomas of the muscles of the limbs and of the connective-tissue planes of the extremities in the museums of Great Britain.

SAMUEL H. KLEIN, M.D.

Carrell, W. B., and Childress, H. M.: Tuberculosis of the Large Long Bones of the Extremities. *J. Bone & Joint Surg.*, 1940, 22: 569.

Tuberculosis of the shafts of the long bones is rare in the United States: only 32 cases have been reported previously in the English literature. The authors present 4 new cases of their own and discuss,

in addition, 74 hitherto unreported cases which were uncovered by a questionnaire sent to 250 orthopedic surgeons in the United States and Canada.

The bones chiefly involved were the tibia (29 per cent) and the femur (27 per cent). Among 95 patients, 14 had multiple involvement. The third decade of life appeared to be the most common age period of onset. The chronicity of the disease is manifested by the fact that nearly half of the patients had had symptoms for over a year. Active pulmonary and other tuberculous lesions are frequently associated with shaft tuberculosis.

In cases without sinuses, the treatment of choice is curettage and saucerization and closure. If sinuses are present, saucerization and packing is an effective treatment. In the reported series the treatment most frequently used was incision and drainage, partly because of an early diagnosis of pyogenic osteomyelitis.

From a differential diagnostic standpoint the conditions to be considered must include syphilis, pyogenic osteomyelitis, coccidioidal infection, Juengling's disease, and Boeck's sarcoid.

DANIEL H. LEVINTHAL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Gill, A. B., Key, J. A., Amberson, J. B., Jr., Swift, W. E., and Others: The Treatment of Tuberculosis of the Spine: A Symposium. *J. Bone & Joint Surg.*, 1940, 22: 795.

GILL. The purpose of this symposium is to discuss the differences of opinion among the authors as to methods of treatment of tuberculosis of the spine, and to arrive at a better understanding of the nature and cause of this chronic disease; to observe and comprehend its phases, variations, and relations to other conditions of the body; and to ascertain whether or not all that might be done to aid nature in the cure of tuberculosis of the spine is being done.

It is true that the foci in soft tissues and in bones may become permanently healed, but it is also true that within twenty years from the onset of Pott's disease many patients die of causes directly attributable to tuberculosis, such as pulmonary, miliary, and meningeal complications. Other complications develop regardless of the primary treatment for the tuberculosis of the spine; they include such conditions as spastic paralysis, renal involvement, and foci in other bones and joints.

The objectives of treatment should include the relief of pain, the healing of the vertebral lesion, the prevention or cure of the deformity so far as this may be compatible with healing, the prevention of relapse or of recurrence of the disease in the spine or elsewhere, and the prolongation of life.

Several pertinent questions asked by the author in relation to the objectives of treatment are: should we regard these cases simply as an orthopedic problem of localized tuberculosis of the spine to be cured in one year or in five years, or should we keep these patients under observation and guidance for many years as does the internist in treating pulmonary tuberculosis? Can we ever forget that the disease is a lurking danger unless the body maintains continually a high level of resistance? In the last analysis, is the local treatment, however valuable, of greater importance than the general treatment of the body as a whole?

KEY discusses *the pathology of tuberculosis of the spine.* It is generally believed that the tubercle bacilli reach the bone in Pott's disease as in other forms of skeletal tuberculosis through the blood stream, usually from foci in the peribronchial or retroperitoneal lymph glands. However, according to Fraser, it is possible that the thoracic duct and its related lymphatics act as conveying routes. Regardless of the route of transmission, the tubercle bacilli reach the area which is to become the site of disease, settle there, and multiply. As the bacilli increase in number there is a reaction in the surrounding tissues. Key gives an excellent detailed description of the various microscopic and gross tissue reactions to the tubercle bacilli.

In tuberculosis of the spine it is usual to classify the cases as of the central, epiphyseal, and anterior types. In a series of 109 lesions in 100 patients studied by Doub and Badgley, the disease was central in 61, epiphyseal in 40, and anterior in 8. It is usually stated that the localization of these various sites in the vertebral bodies is determined by the arrangement of the blood vessels, but this is not a satisfactory explanation and it is still unknown why the spine is peculiarly susceptible to tuberculosis.

In the central type of disease the anterior cortex is usually broken through and the infection spreads beneath the anterior longitudinal ligament to adjacent vertebræ, but it may break through the posterior cortex and posterior longitudinal ligament and completely encircle the dura. This type is usually not diagnosed until considerable destruction has occurred because symptoms are late in appearing.

In the anterior type the spread of the disease is similar to the central type and there is little damage to the intervertebral discs or collapse of any vertebral body until late in the disease. The epiphyseal or intervertebral articular type causes symptoms relatively early and can be diagnosed in the roentgenogram by narrowing of the intervertebral space. It rarely causes collapse of a vertebral body and it may heal without appreciable deformity.

Abscesses which arise above the diaphragm tend to remain in the chest cavity or to point posteriorly. Those which arise below the diaphragm tend to enter the pelvis along the sheath of the iliopsoas muscle and may point in the groin or thigh, or they may burrow posteriorly and appear in the lumbar region. Paraplegia occurs in about 12 per cent of the cases with Pott's disease.

In children the remains of vertebral bodies which are in contact tend to fuse with bone; in adults the fusion is usually of dense fibrous tissue.

It is probable that no tuberculous spine ever heals completely and that there always persist foci of disease, which may become active if conditions arise that sufficiently favor the disease. Key believes that spinal fusion tends to lessen the probability that such conditions will arise and to hasten the healing process if it is done without lowering the patient's resistance too much.

AMBERSON states that tuberculosis of the spine is almost exclusively due to infection with the human type of bacillus. Infected cattle in the United States cause only 0.4 per cent of the cases. With very few exceptions, infection is acquired by inhalation and the primary lesions are pulmonary. The younger the child is, the larger the lesion of caseous lymphadenitis and the greater the liability to hematogenous dissemination. In older persons, particularly those beyond the age of puberty, the greater is the tendency to localization in the lungs, while the tendency toward hematogenous spread is less.

Tuberculosis of the vertebral column accounted for 698 deaths in the registration area of the United States in 1937, 431 in men and 267 in women. This represents approximately 1 per cent of the deaths from all forms of the disease and approximately 12 per cent of the deaths from extrapulmonary tuberculosis.

Whitman reported in 1927 that in 85.8 per cent of the cases the disease developed before the age of ten years. Hellstadius more recently indicated two peaks of incidence, the first between birth and the age of nine, and the second between the ages of twenty and twenty-five years.

Randerath almost invariably found the bone marrow to be invaded in acute generalized miliary tuberculosis, and Koizumi demonstrated tubercle bacilli in the bone marrow in 75 per cent of a series of cases of chronic visceral tuberculosis. If the patient survives, most of these foci become healed or latent, and constitutional or local influences later may be responsible for the exacerbation of some of them. Trauma, for example, may cause reactivation of such a latent focus. Few believe now that the effect of trauma is to establish a focus of lowered resistance in which circulating tubercle bacilli are likely to lodge.

Cave reported that 60 per cent of 122 children with vertebral tuberculosis showed pulmonary lesions at some time during the course of the disease as demonstrated by roentgenograms. Von Hecker found a similar percentage but only 5 per cent of his patients were from twenty-two to twenty-four years old. In negroes, vertebral tuberculosis is a more frequent, serious, and fatal disease than in white individuals.

In the presence of vertebral tuberculosis, a source in the chest should always be assumed and sought, as well as hematogenous lesions in other systems, such as the serous membranes, the lymphatics, and the genito-urinary tract. It is important to recognize these lesions at any time, but especially during the early stages of vertebral disease. Periodic roentgenographic examinations of the chest should be made at frequent intervals, and the urine should be examined regularly for traces of albumin or pus. Suggestive evidence should always lead to further investigation. Too much reliance should not be placed on the observation that vertebral tuberculosis sometimes runs its course as an isolated lesion. Symptoms of toxemia are to be watched for and it is invaluable to make periodic observations of the erythrocytes, sedimentation rate, and blood leucocytes.

There is no substitute for general rest and rest of the local lesion in tuberculosis. Rest treatment should include, as far as possible, the elimination or minimization of such deleterious influences as malnutrition, fatigue, worry, menstruation, pregnancy, and associated diabetes.

Diet is now considered to be important in tuberculosis only in so far that it provides all the necessary elements in suitable amount and quality and that the food is well prepared and tastefully served.

Except for certain superficial tuberculous lesions, it is doubtful whether natural or artificial heliotherapy is lethal for bacilli in the tissues or that it accelerates healing in a specific way.

Attention is called to the principle that in any form of tuberculosis surgical treatment usually is most effective ultimately if it is postponed until the forces of resistance have become organized and the lesion has been stabilized and has started to heal. Surgical treatment may be futile and harmful if started prematurely, especially if the disease is still in the phase of hematogenous dissemination.

SWIFT discusses the *end-results of treatment.* Fusion operations for tuberculosis of the spine were performed on 817 patients in the twenty-year period from 1911 to 1930. Seventy-one per cent of the patients were followed up for at least five years; of these, 61 per cent were followed up for periods of from ten to twenty-four years. The Hibbs' type of spine fusion has been the treatment of choice.

Excellent results were obtained in 72 per cent of the children and in 53 per cent of the older patients. The patients who are in good general condition clinically and whose roentgenograms show the tuberculous lesion to have entirely subsided are listed as having excellent results. A relatively normal appearance of the diseased bone is the ultimate end-result expected to occur after a successful spine fusion. When this point is reached the danger of a recurrence of active tuberculosis in that area is not feared. If roentgenographic evidence of a lessening of the disease activity is not present in from six to eight months, either the fusion is not solid or some unknown factors are stronger than estimated. It is expected that paravertebral abscesses will tend to disappear if they are dependent for their contents on the activity of the vertebral lesion, which effect is frequently observed as early as the fourth month. The average period of recumbency following a spine fusion should be from six to twelve months. Fifteen

per cent of the 584 patients died of tuberculosis; this means that 53 per cent of all the deaths were caused by some form of tuberculosis. Eight patients of the 584 died of shock or infection.

The demonstrable and expected benefits of a successful spine fusion are: rest to the diseased area; subsidence of the activity of the lesion at an early date; maintenance of the kyphos at the minimum degree of deformity; growth of the vertebral bodies in the fused area in children; possibility of the patient's being ambulatory at an early date; and attainment of a permanent healthy roentgenographic appearance of the diseased vertebræ.

CLEVELAND states that an attempt to study a single manifestation of a disease so protean as tuberculosis is difficult and perhaps unwise. It is his belief that the answer to the problem of joint tuberculosis, including tuberculosis of the spine, lies not in methods, techniques, surgical procedures, or alpine sunlight, but in more fundamental and often ignored factors, that is, the extent of invasion by the tubercle bacillus and the patient's reaction to this disease.

The patients were divided into four groups according to the degree of involvement by the disease:

Group A: Patients with no evidence of pulmonary tuberculosis. The mortality rate in this group was 11.42 per cent. Death usually occurred from prolonged suppuration and attendant amyloid disease.

Group B: Patients with pulmonary tuberculosis and negative sputum, but with no metastatic spread to other organs. The mortality rate here was 7.14 per cent.

Group C: Patients with pulmonary tuberculosis and positive sputum. The mortality rate in this group was 44.44 per cent.

Group D: Patients with pulmonary tuberculosis and negative sputum, and with metastatic spread to other organs. The mortality rate among these patients was 68.75 per cent. They are apt to have an invasion of the gastro-intestinal or genito-urinary tracts or lymph glands, and often miliary tuberculosis ultimately develops. There is no certain means of recognizing these conditions until they have declared themselves definitely. Once they are established it is foolhardy to attempt any surgery except of a palliative nature. As the development of metastatic spread in these patients has been observed in the wards prior to any surgery, it is very doubtful if the surgical procedure plays any part in dissemination of the disease.

Since Groups A and B showed a combined mortality of 9.52 per cent, and Groups C and D showed a mortality of 54.54 per cent, it is obvious that the success or failure of any type of treatment, in a given series of cases, will depend upon which groups form a majority of the patients in that series.

The death rate was high, 26.6 per cent in the 203 consecutive patients in this series. The weight-bearing joints were involved in about 95 per cent and the vertebral joints in 52 per cent of all instances of joint tuberculosis. Forty-eight of 203 patients gave evidence of spinal-cord compression. Spinal fusion and prolonged bed rest offer the best means of treatment. Paravertebral, mediastinal, or psoas abscesses are present in a very high percentage of the patients. Repeated aspiration is the treatment of choice although incision and drainage with suture of the wound may be necessary. Spontaneous fusion requires many years and usually entails serious deformity of the spine, and in the end these patients are not adequately protected against the disease. Fusion by surgery accomplishes in from six to nine months what it takes nature to achieve in from five to six years. It is likely that an incidence of at least 10 per cent of failure of fusion may be expected in the hands of experienced surgeons and that with lesser experience the incidence will be higher.

The end-results in the reported 203 consecutive cases of tuberculosis of the spine treated by spinal fusion are: excellent, in 54.18 per cent of the cases, which were followed up for an average of three years and ten months; and uncertain, in 19.21 per cent, followed up on the average of two years and eight months. Death occurred in 26.6 per cent at an average of thirteen and one-half months after operation.

In this series, 62 per cent of the patients were in the more favorable Groups A and B. The 38 per cent in Groups C and D were carefully selected for surgery. This should be borne in mind, as any indiscriminate selection of patients for surgery from the less favorable groups will result in an appalling mortality.

There are 50 patients who were followed up for five years or more. Two of these died, each six years after operation. The remaining 48 had excellent results and were followed up for an average period of slightly more than seven years.

Healing of vertebral lesions is accomplished by fusion either of the vertebral bodies or of the laminæ, with recalcification of the diseased bodies and subsidence of clinical symptoms. The diseased vertebræ tend to settle together until sound or recalcified bodies are in contact.

The patient's general reaction to tuberculosis is the most important single factor in healing. If he falls into Group A or B, his chances of healing are excellent; if he belongs to Group C, his chances are fair or worse; and, finally, if he falls into Group D, his chances are poor.

The cause of death is usually tuberculosis.

In a small group of 50 patients with excellent results, with an average follow-up of seven years, only 2 died of tuberculosis after six years.

MEYERDING. Although a diagnosis of tuberculosis of the spine was made in 2,080 patients, a surgical fusion was performed on only 480 patients (23 per cent). In this group of 480 patients, the average age was more than thirty years and the average duration of the symptoms was two and one-half years; more than 50 per cent of these patients had not had previous treatment. Thus, this constitutes a series

of cases that differ in type from those reported by some authors working in other orthopedic centers. Of 480 patients, only 4 per cent were children, operation having been carried out principally during the earlier years of the author's experience. Spinal-fusion operations are rarely done on children at the present time because conservative measures are preferred.

When fusion is produced, the region of involvement in the spine is immobilized, thus effecting something which no other form of fixation, such as that obtained by means of plaster jackets, braces, or recumbency, can bring about. In such cases, respiratory motion and other muscular movements no longer add their trauma to an already diseased tissue.

Operation to produce surgical fusion of the spine is a comparatively safe procedure. It may be performed without danger of aggravating the disease process. It aids in giving stability to the diseased portion of the spine. It does not necessarily prevent extension of the disease, formation of abscess, irritation of the spinal cord, or paraplegia among patients whose resistance is not good. It is best to delay spine fusion in children who are sick; then, when the process becomes quiescent, it can be employed to obtain an internal splint to aid in ankylosis. The results of spine fusion as a treatment for tuberculosis of the spine are probably better in adults than in children. An operation that produces fusion of the entire region of involvement gives better immobilization and, consequently, better results than does one that effects fusion of a more limited region. It is often impossible, in the early stages of tuberculosis of the spine, to determine the exact extent of the process either by clinical or by roentgenographic examination.

At the end of five years, 396 of 480 patients had been traced; of these 396, 63.64 per cent had returned to an occupation, 7.83 per cent showed improvement in their condition, 3.79 per cent had shown temporary improvement, and 18.43 per cent had died.

The best results are obtained when patients are carefully selected for operation, when spine fusion is employed during the period of healing of the disease, and when such treatment is reinforced by conservative treatment for a prolonged period of time.

The paramount requirement for every patient who has tuberculosis of the spine is rest, heliotherapy, and a nutritious diet. No surgical treatment can offset the value of conservative treatment.

In addition to his report Meyerding has included an excellent review of divergent opinions as expressed in the literature on various factors involved in the treatment of tuberculosis of the spine.

CHANDLER and PAGE selected 39 consecutive cases for their study. These cases were studied and compared with 36 cases treated conservatively during a previous five-year period. Final end-results could not be obtained in some instances. The Hibbs technique was used in all cases. Sections of rib or tibial grafts supplemented by bone chips at the site of pseudarthrosis were used in 4 cases in which secondary operations were done. One patient was operated upon three times.

Good results were obtained in 25 cases (64.10 per cent). In 4 cases (10.26 per cent) in which the patients were followed for only three years the results were good at the end of the observation period. In 3 cases (7.69 per cent) there was continued activity of the disease, and in 1 case of paraplegia (2.56 per cent), there was some return of motor function. There were no deaths due to operation. Six deaths (15.39 per cent) occurred in the total series of 39 cases. All were caused by tuberculous lesions and occurred from four months to five years following operation.

The authors agree with all the accepted nutritional, hygienic, and supportive measures, and, with some reservations, with the principle of rest. They seek the amount of rest compatible with normal physiological functioning of the patient as a whole. Absolute rest is accompanied by atrophy even of normal structures and necessarily by impairment of their normal physiology. Frequent postural changes and active use of the extremities are encouraged. Every effort to splint the area of disease itself is carried out. This can be done best by surgical fusion of the involved area of the spine, provided the operation is not shock-producing or devitalizing to the patient.

At best a spinal fusion is only a part of the treatment of tuberculous spondylitis. The authors believe that it has been helpful. They do not use the term "cured" because this means that the follow-up in a case of tuberculosis of the spine should be life-long.

An analysis of 63 cases of tuberculosis of the spine, in patients all under twelve years of age, is the basis of ADAMS' report. The percentage of deaths was 40 and that of recoveries 60.

Careful thorough fusion of the laminæ produces an internal splint and is an aid in the healing of the disease. The fused areas will bend, and no weight should be put on the bodies in the center of the kyphos until the healing is well advanced. No operations were performed until the general condition was improved. The types of fusing operations used were the Hibbs and Albee; osteoperiosteal grafts were also used. Laminectomies were done in some instances.

In tuberculosis of the lumbar spine in children, when the process apparently has started in the disc and has invaded the bottom of the vertebra above and the top of the vertebra below, solid bony fusion will result in two or three years, without any operative interference. The use of sulfanilamide in these cases is not warranted. It clears up the intercurrent infection, if there is a mixed infection, but it does not attack the tuberculous organism because of its waxy capsule.

Eighty cases were reviewed by Harris and Coulthard and the data so obtained is the basis for this report. Spine fusion is of value because, prop-

erly performed, it maintains rest in the diseased segment of the spine more efficiently than does any other method and it does so for the remainder of the patient's life. It is the authors' opinion that rest obtained by spine fusion ensures a more rapid cure of Pott's disease, with greater certainty and less likelihood of recurrence, than any other form of treatment.

The basic plan has been to treat the patient by recumbency and fixation for a length of time sufficient to enable him to obtain mastery of the infection. The Whitman frame has been found to be the most convenient apparatus on which to carry out this regimen. During this period of recumbency the spine is fused. Fusion is not undertaken until the patient shows signs of mastering the infection, and at least six months must elapse after fusion before it is safe to allow him to get up. Favorable cases are recumbent for a year, during the middle of which period a spine fusion is performed. Three months' ambulatory treatment follows so that the minimum period of hospital treatment in favorable cases is about fifteen months. A variety of circumstances may necessitate lengthening the period of recumbency. The presence of a persistent psoas abscess or lumbar abscess, of discharging sinuses which interfere with the field of operation, and of foci of tuberculosis elsewhere in the body, and failure of the patient to display evidence of mastering the infection rapidly all necessitate longer treatment.

Fusion is obtained by using large and relatively heavy bone grafts. For this purpose, two grafts are taken from the shin. They are turned on edge and their cancellous surfaces placed against the denuded spinous processes of the involved vertebræ and of one normal vertebra above and one below. Cancellous bone and chips, also taken from the tibia, are packed into the interstices of the field of operation. The two large grafts are fastened in place by stainless-steel-wire sutures through the upper and lower ends. This operation has the advantages of simplicity and rapidity while it ensures rigid fixation of the involved segment of the spine.

Healing is classified into four types:

Healing by bony ankylosis. In this type the remnants of the involved vertebral bodies have fallen together and have fused into a solid pyramidal mass of bone which represents what is left of two or more carious bodies. The bone graft is solidly fused to the spines of the involved vertebræ and to at least one normal vertebra above and below. The patient presents clinical evidence of cure, normal temperature, no pain, ability to undertake reasonably heavy activity; the abscesses disappear and the sinuses close; and adequate weight is maintained. One can say with great certainty that the patient is cured.

Healing by firm fibrous ankylosis. The involved vertebral bodies (usually only two) do not fuse with bone. They are separated by a narrow space occupied by the remnant of the intervertebral disc. The space is small and the spinal bone graft is solid and of adequate extent. The clinical evidence of cure is as already stated. Probably these cases represent just as perfect cures as do the previous group, although the roentgenogram lacks the definite evidence found in the group with bony ankylosis.

Healing without ankylosis—unstable spine. The vertebral bodies are separated by a considerable space due to too much hyperextension at the site of the disease, calcific débris from an abscess, or a sequestrum. The bone graft is fused to an adequate number of spinous processes but it may fracture at the level of the disease because the involved bodies are not stable and great strain comes upon the graft. The clinical evidence of cure may be present or there may be pain on effort. If the graft fractures, exacerbation of the disease may result.

Failure to heal or extension of the disease. The outstanding feature is progressive caries in the grafted area or extension of the caries into vertebral bodies beyond the bone-grafted area. The clinical evidence of active disease, including abscess, is present.

Abscesses occurred at some stage in 90 per cent of the cases. The authors gradually extended the field of aspiration and now use it for the mediastinal abscess. This must be done under roentgen control and is not easy, but yields valuable diagnostic information and materially aids in the treatment. Heliotherapy is regarded as a most valuable adjunct in most cases. Abscesses are treated by repeated aspiration, whenever possible. Usually this is sufficient to dispose of the abscess, although occasionally it continues to increase in size in spite of aspiration. In such cases listerian drainage is utilized (drainage through a small wound into a continuously antiseptic dressing made with Keith's solution). The glycerin base ensures its remaining active for at least twenty-four hours. Secondarily infected sinuses are difficult to treat and only occasionally are they cured. The authors have had some success by irrigating the sinuses with Dakin's solution, and 1 case (in which the secondary organism was the hemolytic streptococcus) was cured with sulfanilamide. Amyloid disease occurred in 13.75 per cent of the cases. The diagnosis was made by an improved Congo-red test. Renal or genital tuber-

TABLE I.—ANALYSIS OF THE RESULTS OF TREATMENT

Result	Method				Total	
	Recumbency and bone graft		Recumbency only			
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Bony ankylosis	33	66.00	7	23.33	40	50.00
Firm fibrous ankylosis	10	20.00	1	3.33	11	13.75
No ankylosis	4	8.00	3	10.00	7	8.75
Progressive disease	3	6.00	19	63.34	22	27.50
Total	50	100.00	30	100.00	80	100.00

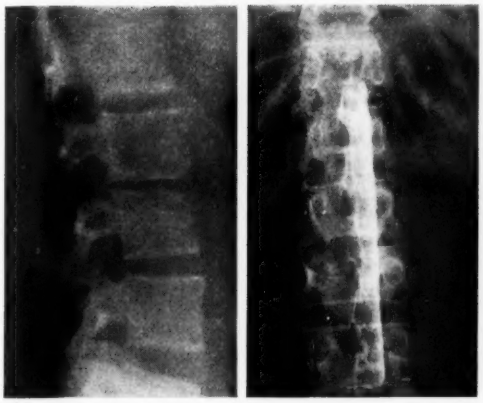

Fig. 1. Healing without ankylosis of the vertebral bodies. Unstable spine. In this example, although the bone graft is solidly fused to the spinous processes the vertebral bodies are separated by hyperextension and, consequently, all the stress of weight-bearing comes upon the bone graft.

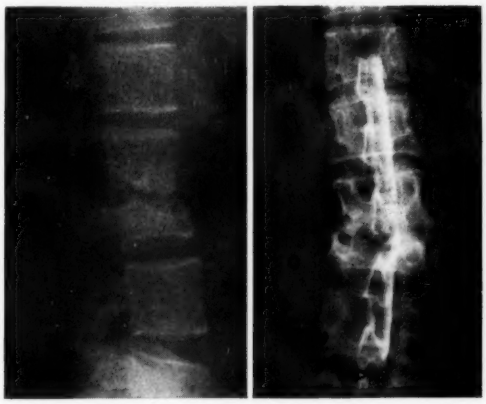

Fig. 2. Eighteen months later, the strain upon the bone graft resulted in its fracture with collapse of the vertebral bodies into one another. This was followed by an exacerbation of activity of the disease which was treated by further recumbency and a second bone graft. The fracture in the first bone graft healed spontaneously, with ultimate bony fusion.

culosis occurred in 26.25 per cent of the cases. Routine examination of the urine for tubercle bacilli is as much a part of the management of a case of bone and joint tuberculosis as is examination of the chest. Addison's disease was present in 3.75 per cent and paraplegia in 16.25 per cent of the cases. No cases of paraplegia occurred in Pott's disease of the lumbar vertebræ. In 2 cases it occurred during the period of immobilization at a time when the active disease in the bone seemed under control, and in 3 additional cases it occurred several years after the Pott's disease was apparently cured. This complication is obscure in its exact pathology and its treatment is difficult and uncertain. Active pulmonary tuberculosis was a complication in 30 per cent. The general mortality in the 80 cases was 28.75 per cent. In the group treated by bone grafting the death percentage was 12. Tuberculosis in various forms was the chief cause of mortality. The conservatively treated group of 30 patients had a mortality of 56.57 per cent, but these patients included a high proportion of unfit surgical risks.

Among the relapses or severe complications occurring after healing were 9 cases of fracture of the bone graft. In 1 case with exacerbation of activity, immobilization and a second graft were required. Ultimate cure resulted. The remaining 8 patients had few symptoms and required no special treatment. The fractured grafts all united. This may seem a high incidence of fracture of the graft. It can be explained as follows:

The authors have been diligent in the periodic review of their cases and have made careful roentgenographic scrutiny of the graft an essential part of the review. Moreover, the type of graft used lends itself well to visualization in the roentgenogram. The large double grafts from the tibia show well, and if they are fractured this also shows more clearly than in the usual Hibbs or Albee technique. Several of the fractures were discovered only on roentgenographic review; the patients had made no complaint, and nothing in the clinical examination suggested fracture. The authors believe that the spine should be fused with the diseased bodies in contact, even though this means the existence of a certain amount of deformity. (See Figs. 1, 2, 3.)

Sixty-six cases were observed by Mayer and spine fusions were done in 37 while 29 were treated conservatively. In studying this group of operative and non-operative cases, care was taken to classify the patients as accurately as possible with regard to duration of the disease, the number of vertebræ involved, the presence of abscess, and age. This study was based on a fifteen-year observation period.

It is impossible to make a positive diagnosis of tuberculosis of the spine in the early stage, since other diseases may give similar symptoms, physical signs, and roentgenographic appearance.

Since spine fusion involves only the laminæ and the intervertebral articulations, and because the healing of the invaded bodies usually takes place by the so-called block process in which a fusion of one or more bodies occurs, the operative fusion will tend to interfere with the natural process of healing if performed at a stage antedating the pathological fusion of the bodies, and if the fused laminæ prevent flexion. The operative fused area bends approximately 10 degrees or more.

Exactly the same pathological changes may and do occur in the fused as in the unfused cases. The general treatment is more important than the local.

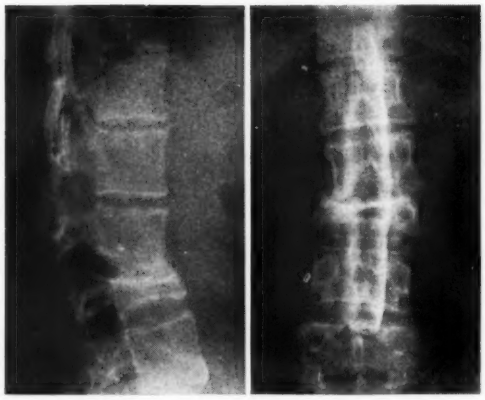

Fig. 3. The ultimate result after the exacerbation had been treated by a further period of recumbency and another bone graft. Healing by bony ankylosis.

In general, the lower the site of the lesion is, the less the tendency toward deformity. In cases involving the fourth or fifth lumbar vertebra or the fifth lumbar vertebra and the sacrum, healing occurred without any deformity. In the upper lumbar area the deformity was slight, with or without fusion. In the thoracic region, with involvement of three or more vertebræ, more deformity occurred; this was most marked when the sixth or seventh thoracic vertebra formed the center of a focus of seven or eight vertebræ.

The mortality in the entire 66 cases was 12 per cent. The causes of death were tuberculous meningitis, amyloiditis, or pulmonary involvement. There was only 1 case of proved involvement of the kidney and 2 of the lungs.

The author concludes that if the fusion operation is performed during the active stage of the disease in children under eighteen years it will not abbreviate the course of the tuberculous process. On the other hand, if it is done during the reparative stage, in patients who have a collapse of three or more of their vertebræ, it has a beneficial effect in strengthening the structurally weak spine.

ROBERT P. MONTGOMERY, M.D.

FRACTURES AND DISCLOCATIONS

Annersten, S.: Experimental Studies on the Osteogenesis and the Biochemistry of the Fracture Callus (Experimentelle Untersuchungen ueber die Osteogenese und die Biochemie des Fracturcallus). *Acta chirurg. Scand.*, 1940, 84: Supp. 60.

The theory that the source of supply in the regeneration of bone is the cells peculiar to the bony tissue seems to be constantly losing ground. With regard to the formation of fracture callus, this implies that osteogenesis does not completely explain the so-called metaplastic bone formation. Inasmuch as it has been shown that morphological investigations on callus cannot solve the etiological question of osteogenesis, this was studied experimentally on heterotopic bone formation. It was found that an alcoholic extract of normal bone tissue may produce cartilage and bone formation in muscle. Further studies have shown that a specific osteogenetic substance, which can be extracted by the usual fat-soluble substances (alcohol, ether, and benzol) is effective and can be increased in its efficacy by concentration. This substance is not specific with regard to individuals or types and resists heating up to at least 78° C. A prerequisite for its effectiveness seems to be the presence of young, newly formed cells, namely, pluripotent cells, which are determined by the osteogenetic substance.

Inasmuch as this substance is localized in bony tissue (it may possibly also be extracted from cartilage), the possibilities that it is transported to the body by the blood and that it also occurs in the urine are discussed. This suggests a uniform etiological osteogenesis of heterotopic bone formation. In regard to the formation of callus, it is clear that the osteogenetic substance, just like calcium, penetrates into the surroundings from the fracture fragments and acts favorably upon the pluripotent, newly formed cells. As soon as these cells have attained a fixed determination, the differentiation process proceeds. Bone ground substance is formed first. The author then discusses some local chemical ossification processes; however, his findings cannot as yet be considered as conclusive.

Even though several authors believe that the composition of the bone salt is still an open question, numerous findings still indicate that it is a multiple phosphorite, the main constituent of which is a tertiary calcium phosphate, together with calcium carbonate and calcium hydroxide. The differentiation induces the precipitation of this substance. The prerequisite seems to be certain colloid chemical changes of the organic substance. On the basis of his own work the author believes that the rôle of the organic substances in the ossification of the callus is an increase of the nitrogen content with the progress of the ossification.

The ossification in the callus is characterized by an increase of the phosphorus and calcium values which is accelerated with the increasing age of the callus. It was found that the phosphorus starts from a lower initial level than the calcium. During the first few days after the fracture this shows a considerably higher percentage in the surroundings of the site of fracture than, for example, in the surrounding musculature. After about seven days, however, the calcium content increases more rapidly than the phosphorus content, but the increase occurs in such a manner that the calcium to phosphorus ratio is 1:2, the ratio that is also found in completed bone.

The results of this investigation indicate that the ossification, for the moment, proceeds without any local enrichment of any "excess calcium." A local increase of the ester phosphorus or lipoid phosphorus

does not appear. On the other hand, the so-called direct phosphorus increases when the water content of the callus is considered. At the same time these fractions, when compared with the phosphorus associated with the calcium, are very small, and this latter phosphorus corresponds practically with the entire increase of the phosphorus content. It appears, therefore, that calcium and phosphorus are taken up directly from the blood in the process of ossification.

These studies have also shown that the phosphorus content of the blood plasma (probably lipoid and residual phosphorus) increases, in contrast with the calcium content in the formation of callus.

The increase of the insoluble carbonate occurs in the ossification of the callus only at a later stage than the increase of the calcium and phosphorus. On the other hand, the increase of the bicarbonate content is distinctly discernible even in the early stage. The bicarbonate is probably associated with the formation of carbonate and also exerts a favorable, local, alkalizing effect. The pH determinations (both by electrometric determination and by gasometric calculation) show that with increasing age of the callus there results a considerable alkalization (from about pH 7.5 on the fourth day to about pH 9 on the twenty-fourth day). This alkalization (the conditions of which were not entirely explained in this study) partly favors the precipitation of tertiary calcium phosphate directly and partly favors the effect of the phosphatase.

The well-known fact that the phosphatase content of the callus tissue is considerably increased could also be confirmed in this study.

LOUIS NEUWELT, M.D.

Wilson, J. C.: Fractures of the Neck of the Femur in Childhood. *J. Bone & Joint Surg.*, 1940, 22: 531.

The author presents 10 cases of fracture of the femoral neck in children following end-result studies to show the dangers which follow such injuries and to suggest treatment. Seven patients were males. Four were in the first decade of life and 6 in the second. In only 1 case was trauma slight and in this case there was a paralyzed extremity. All fractures occurred centrally or near the base of the neck. Eight of the patients were treated with a Whitman cast. In 7 instances satisfactory reduction was not maintained. The slipping of the fragments was discovered in 1 case early enough to allow correction and transfixion of the shaft of the femur by a pin which was incorporated in the cast. In 1 patient the femur was nailed, but, through no fault of the procedure, the case terminated unfortunately. An oblique subtrochanteric osteotomy was done in 1 case in which the hip was dislocated, because of muscle weakness following infantile paralysis. It was hoped that the osteotomy would stabilize the hip and facilitate healing of the fracture, both of which results were accomplished. One patient with non-union of the fracture died from shock the same day an intramedullary bone grafting was done. One of the 9 remaining patients was injured only two months previous to the report so that the outcome cannot be anticipated. Of the remaining 8 patients, 2 have good functional results.

Fractures of the neck of the femur in childhood are serious injuries. Maintenance of reduction in the Whitman cast is difficult. Perhaps a nail would be more effective, but there is a possibility that the epiphyseal plate may be damaged by its use. Growth changes are to be expected although they do not conform to the classic picture of Legg-Calvé-Perthes' disease as has occasionally been reported. Irrespective of the cause for the growth disturbances, direct injury to the vascular supply or to the nerves controlling the blood vessels, gross disturbance of joint mechanics usually follows. Such joints must show premature evidence of wear and tear, which is commonly called degenerative arthritis. Oblique subtrochanteric osteotomy is helpful in bringing a limited arc of motion into useful planes.

ROBERT P. MONTGOMERY, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Efskind, L.: Vascular Changes after the Intravenous Injection of Thorium Dioxide (Thorotrast) (Vaskulaere Veraenderungen nach intravenoeser Injektion von Thoriumdioxyd [Thorotrast]). *Acta chirurg. Scand.*, 1940, 84: 177.

Efskind's studies on vascular changes after the intravenous injection of thorium dioxide (thorotrast) originated from two questions: (1) Are the mesothelium of the peritoneum and the vascular epithelium, which cannot be differentiated histologically, identical biologically with regard to their behavior following the injection of thorotrast? and (2) Is the intravenous injection of thorotrast clinically harmless? The studies were carried out on 30 rabbits which received 3 c.cm. of thorotrast injected into the auricular vein and were examined from one to one hundred and sixty days after the injection. The author's findings were as follows:

Thorotrast is deposited rather fast in the cells of the reticulo-endothelial system. Although there is no definite deposition of thorotrast or other vital pigments in the vascular epithelium, the former is nevertheless deposited in large amounts in the peritoneal epithelium, after intraperitoneal administration.

After a single intravenous injection minor signs of degeneration appear in the vascular epithelium at the end of the first day. They consist of pycnosis with disappearance of the chromatin structures; this is followed by shrinkage of the nucleus, and later also by changes of its form, as the first signs of a segmental nuclear rhexis. More advanced stages bring changes of the cell body as well, with disappearance of the cell borders. The peak of the degenerative changes after the injection of thorotrast occurs on the second day, when vacuolization in the cytoplasm is also found. These changes are usually reversible, and the death of a cell is rare. When it does occur, the defect seems to be closed by changes of form and volume of the surrounding cells, not by mitosis. After one week the changes have completely disappeared and even after prolonged observation no proliferative or degenerative changes of the vascular endothelium can be found; on the other hand, the author has found changes in the peritoneal mesothelium months after the intraperitoneal injection of thorotrast.

As to the other layers of the vascular wall, thorotrast deposits are frequently found in the aorta. They may reach a size of 1 by 2 cm. and may lead to destruction of the elastic substance at their site.

Therefore, the vascular walls are not indifferent to thorotrast; small, but distinct, degenerative changes follow its injection. In addition, marked deposits with destruction of the elastic substance in the media are frequently found; in the experimental animals, the deposits are found especially at the sites of local injury (at an experimental puncture wound and a narrowing of the lumen) and it is likely that preexisting vascular diseases increase the formation of these deposits. In veins, degeneration was found, but there were no deposits. Because of their different behavior following the injection of thorotrast Efskind thinks that there is only a morphological resemblance between the peritoneal and the vascular epithelia. Though his experimental doses exceed the amounts used clinically in vasography, he discourages the use of this method of examination, especially in diseased vessels. HEINRICH LAMM, M.D.

Dodd, H., and Oldham, H.: The Surgical Treatment of Varicose Veins. *Lancet*, 1940, 239: 8.

When incompetent valves are present in the saphenous veins, high ligation and injection are the procedures of choice for the treatment of the varicosity. The great saphenous vein must be tied at its junction with the femoral vein. In some instances, in addition to the high ligation, it is necessary to divide and inject the great saphenous vein just above the knee. A group of 486 cases form the basis of this report.

The efficiency of the valves of the saphenous vein is determined by the cough, Trendelenburg, and tourniquet tests. These tests are described and discussed in detail. Healing of ulcerations is brought about by complete treatment of the varicosities. If the valves in the saphenous vein are competent, varicosities will respond to injections alone. Contraindications to operation or injection are (1) occlusions of the deep veins as determined by the tourniquet test, (2) arterial degeneration, and (3) pregnancy and pelvic tumors.

In regard to the operation, the patient is prepared as for a hernia operation. The veins should be marked beforehand with a dye. Local infiltration with ½ per cent procaine is done for anesthesia, but gas may be used. The upper end of the great saphenous vein lies under a vertical line dropped from the pubic spine. All tributaries of this vein must be ligated and severed. Each end of the divided vein itself must be doubly ligated with a transfixing suture. If the valves between the saphenous veins and deep veins are incompetent, additional ligation of the saphenous vein above the knee is necessary, care being taken to avoid injury to the saphenous nerve. Ligation of the small saphenous vein at its junction with the popliteal vein is necessary in certain cases.

The injection is made through a ureteral catheter inserted down the vein. The authors advocate a "twin injection" consisting of (a) quinine and urethane and (b) lithocaine. From 2 to 4 c.cm. of each of these solutions are injected. A 30 per cent solution of sodium salicylate (from 5 to 10 c.cm.)

also makes a satisfactory sclerosing agent. "Ethamolin" is inferior to the afore-mentioned solutions. The use of sodium morrhuate is strongly condemned because of the severe local and systemic reactions.

An elastoplast bandage is placed on the extremity from the toes to above the knees for four or five weeks. Any residual varicosities are treated with subsequent injections. LUTHER H. WOLFF, M.D.

Holman, E.: The Anatomical and Physiological Effects of an Arteriovenous Fistula. *Surgery*, 1940, 8: 362.

That an arteriovenous fistula has profound effects upon the circulatory system is universally recognized, although the explanation for some of these effects is still subject to controversy. Particularly puzzling has been the effect upon the size of the heart, which is said invariably to become enlarged in consequence of the fistula. The author observed, in animal experimentation, that in the first twenty-four to forty-eight hours after the establishment of a large arteriovenous fistula, the heart diminishes in size, and if the animal survives, there is a prompt return to normal, and, subsequently, a gradual dilatation which may be apparent within four or five days. Death due to an excessive diversion of blood through the fistula may occur and is accompanied by a marked diminution in cardiac size. A marked diminution in cardiac size accompanies shock. A marked decrease in cardiac size also accompanies hemorrhage, the diminution in the size of the heart being commensurate with the degree of blood loss. The size of the heart conforms accurately to the volume of blood flowing through it.

The dilatation that accompanies an arteriovenous fistula is not restricted to the heart, but affects the vessels involved in the fistulous circuit. The same cause is responsible for both dilatations; namely, an increase in the volume or bulk of blood flowing through that part of the circulatory system through which the blood short circuited by the fistula must flow; i.e., all the chambers of the heart, the proximal artery, fistula, and the proximal vein.

To determine more accurately the effects of an arteriovenous fistula, experiments were undertaken in the growing animal and revealed that the dilatation may be very great without evidence of decompensation and may be accompanied by pronounced hypertrophy. It is suggested that when dilatation outstrips hypertrophy, decompensation occurs; when dilatation is paralleled by an equivalent hypertrophy, great enlargement and dilatation of the heart may occur without decompensation. In a crucial experiment involving 3 litter mates of equal weight and stature, 1 acting as control, 1 having an aorta-vena-cava fistula 12 mm. in circumference, and 1 having an aorta-vena-cava fistula 18 mm. in circumference, there occurred increases in the blood volume commensurate with the size of the fistulas. In the same animals an increase in the capacity of the circulatory systems occurred, also commensurate with the size of the fistulas. The increase in capacity and the increase in blood volume closely paralleled each other.

In an animal with bilateral femoral fistulas the increase in blood pressure and reduction in pulse rate were greatest when both fistulas were closed simultaneously, and considerably less when either fistula was closed separately. The physiological effect of a fistula, therefore, clearly depends upon the volume of blood diverted through the fistula, which is determined by its size.

The transient high systolic and diastolic pressures that persist for several days following operative closure of a fistula are due to the increase in blood volume that has occurred during the existence of the fistula. The permanent elevation of diastolic pressure is secondary to the elimination of an area of decreased peripheral resistance.

In animals having bilateral femoral fistulas, vena-caval pressures were highest with both fistulas open, least with both fistulas closed, and intermediate pressures were obtained on closing one or the other fistula separately. Venous pressures proximal to a fistula are determined by the volume of blood diverted through the fistula and therefore by the size of the fistula. HERBERT F. THURSTON, M.D.

Arkannikova, A. A.: The Ligation of the Femoral and Subclavian Veins as a Method of Treatment of Gangrene of the Extremities. *Nov. khir. arkh.*, 1940, 46: 114.

Ligation of the femoral vein may occasionally constitute the sole method of treatment of gangrene of the lower extremities, but usually the operation supplements other procedures. Ligation alone is not sufficient because it exerts only a local effect. Anemia and lowered temperature of the involved extremity, accompanied by pains caused by an insufficient blood supply, form the most frequent indications. Alleviation of pain by the lowering of the affected extremity justifies an expectation of good results after the ligation. Conversely, the presence of dilated veins contraindicates ligation of the femoral vein because the dilatation of veins as such demonstrates the presence of stasis, and stasis is the result desired when ligation of the femoral vein is done in order that dilatation of collaterals may follow.

A ligation of the subclavian vein supplementing a ligation of the corresponding artery diminishes the danger of gangrene of the upper extremity by preventing a marked fall of the blood pressure.

JOSEPH K. NARAT, M.D.

BLOOD; TRANSFUSION

Ahlborg, N. G., and Brante, G.: Parallel Investigations into the Ascorbic-Acid (Vitamin C) Content in the Blood Plasma and into the Strength of the Cutaneous Capillaries in Healthy Children. *Acta med. Scand.*, 1940, 104: 527.

The ascorbic acid of the blood and capillary fragility of 61 healthy children, from seven to fourteen years of age, were determined, the former by the

Mindlin-Butler method, the latter by Goethilin's technique. The Goethilin technique is as follows:

The number of petechiæ in a small area on the forearm, seen with a 5 diopter lens, after 35 mm. of mercury pressure is maintained for fifteen minutes on both arms, is multiplied by 2, and the number of additional petechiæ found at least an hour later, after 50 mm. of mercury pressure is maintained for fifteen minutes on both arms, is added to this figure. The result is called the petechial index (P.I.).

A close negative correlation between the level of the blood ascorbic acid and the petechial index was found in the 61 children. In 6 cases with low ascorbic-acid values (0.0—0.3 mgm. per cent) and elevated petechial index (16–53) raising the blood level by the daily ingestion of 100 mgm. (0.6—1.8 mgm.) resulted in a marked lowering of the petechial index (0–7). PAUL STARR, M.D.

Scarborough, H., and Thompson, J. C.: Studies on Stored Blood; The Oxygen Capacity of Stored Blood. *Edinburgh M. J.*, 1940, 47: 567.

The clinician frequently employs blood transfusion as a therapeutic measure to increase the oxygen-carrying power of the blood of the patient. Fresh blood from healthy female donors has an average oxygen capacity of 17.6 c.cm. per 100 c.cm. of blood. Now that stored blood is becoming readily available and is being used increasingly, it is obviously of importance to determine whether or not the oxygen capacity of the blood is influenced in some way by storage.

In the method employed by these authors, the blood was removed from the donors with the closed apparatus described by Stewart. The anticoagulant was 3.8 per cent sodium citrate, 1 part of the citrate solution being mixed with 9 parts of the blood. The blood was at once divided into the appropriate number of specimens and stored at from 2° to 5° C. Hemoglobin was converted into acid hematin and estimated by the method of Newcomer. The oxygen capacity was measured by the method of Van Slyke and Neill. Since the changes that occur during the first thirty days are the most important, this period has been investigated more closely. All the results show that during that period the tendency for the hemoglobin and oxygen capacity to fall is practically nil. Later, however, the tendency becomes appreciable.

In conclusion, the authors state that neither the hemoglobin content nor the oxygen capacity of the blood is impaired to an important extent by storage under the conditions described for periods up to thirty days. HERBERT F. THURSTON, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Gray, H. K., and Chauncey, L. R.: Pre-Operative and Postoperative Care and Postoperative Complications in Gastric Surgery. *Surg. Clin. North Am.*, 1940, 20: 989.

The pre-operative care of patients undergoing gastric surgical treatment must be considered as an individual problem. For a large group of patients, little or no pre-operative care is necessary. Such patients may seek surgical relief of inflammatory processes of the stomach or duodenum that have not responded to medical management. Pre-operative gastric retention is not a problem and these patients are not suffering from marked undernutrition. The surgeon may be assured of the presence of adequate renal function by such simple tests as estimation of the blood urea, routine urinalysis with particular attention to specific gravity, and estimation of the amount of urine voided daily. Simple inquiry as to tolerance of exercise will inform the surgeon of the function of the cardiovascular system. In such a situation no prolonged pre-operative care is necessary.

A second group of patients, however, presents a different problem, a problem arising from the effect of obstruction at the outlet of the stomach, referable to organic lesions, neoplastic or inflammatory, or to spasm. Careful consideration must be given to the resultant undernutrition, depletion of the vitamin stores of the body, the presence of extrarenal azotemia, and secondary anemia, as well as to local phenomena such as the presence of gastric dilatation. These problems must be considered from two aspects: first, the specific complication and, second, the resultant general effect on the patient.

The length of time involved in pre-operative treatment obviously must vary with the individual patient. The presence of malignancy does not permit of too great delay, and a few days' or a week's treatment is all that should be permitted in spite of marked retention. When benign lesions are present, however, the optimal time should be chosen.

The principles involved in postoperative care may be divided into those generally applicable to surgical patients and those relative to gastric surgery in particular. Of prime interest postoperatively is the prevention of shock and postoperative pulmonary complications. During the first twenty-four hours after operation the patient is kept in a modified Trendelenburg position. After this period the shock blocks are removed and the patient assumes a low semi-Fowler position. All patients receive a mixture of 5 per cent carbon dioxide and 95 per cent oxygen by inhalation, administered every hour for approximately three minutes. When it appears that patients respond well to verbal encouragement to breathe deeply, the carbon dioxide is discontinued. All patients who are to undergo a gastro-intestinal operation have the stomach lavaged in the morning before the operation. Following the operation, the indications for aspirating the contents of the stomach vary according to the different surgical procedures that have been performed. Patients for whom gastric resection has been carried out do not have aspiration of the stomach contents unless some indication is present. Such indications are the presence of hiccough, any amount of emesis, a vague but definite sensation of fullness, or an increasing pulse rate.

For some years a similar routine was also followed in cases in which gastro-enterostomy had been performed. However, recently, patients who have undergone gastro-enterostomy are subjected to aspiration of the gastric contents twice daily postoperatively until the amount of secretion obtainable is less than 100 c.cm.

One of the primary essentials in the administration of parenteral fluids is that some method of charting be adopted, so that an accurate balance of fluid intake and output is readily available. The arbitrary principle has been adopted that fluid intake for an average adult must exceed the measurable fluid output by 1,000 c.cm. daily, and that enough fluid must be given to insure excretion of at least 1,000 c.cm. of urine daily. Generally, from 2,000 to 3,000 c.cm. are sufficient for the average patient. Fluid for parenteral administration may be given via different routes.

The usual patient for whom surgical procedures on the stomach have been carried out, if this patient is one in whom little or no retention is present, may receive fluid orally forty-eight hours after operation. Supplementary parenteral administration of fluids should be continued until the patient is able to take 2 liters of fluid orally per day.

The average patient who has undergone a gastro-intestinal surgical operation tolerates mild laxatives very well. Routine orders for enemas never should be permitted. If an undue quantity of barium is found in the colon at the time of operation, the early and frequent use of oil retention enemas will be appreciated by the patient.

Mayo, C. W.: Malignant Disease of the Colon; Pre-Operative Preparation and Postoperative Care. *Surg. Clin. North Am.*, 1940, 20: 1033.

Those who have had a particular interest in surgical lesions of the colon are agreed that one of the great advances in that field of surgery and its results have been due not to more skilled surgical technique, but to the application of advancing knowledge in the many allied fields of medicine.

The wise surgeon recognizes the great importance of detail, not only in all that is concerned with the

surgical operation itself, but also with all that has led up to it and all that follows it. Some detail, attended to or neglected in any phase of the care of the surgical patient, may decide his fate; no one phase, pre-operative, operative, or postoperative, is all-important.

Pre-operative preparation begins when the diagnosis of surgical malignancy of the colon is established. Each individual presents not only a physical problem, but also a mental one, and much of the initial preparation of the patient for operation is of a mental nature. An attitude of confidence must be instilled into the patient: confidence in the surgeon, confidence that everything will come out all right, and that he or she will live. Physical conditioning can be divided into two parts: one is concerned with the patient as a whole, to prepare the body to tolerate the necessary surgical procedure by mobilizing the defense troops available in the body and by supplying them from other sources when such additional support may be necessary or helpful. The second part is concerned with the cleansing of the colon for the purpose of lowering the risk of soiling at the time of operation and to facilitate the necessary technical procedures during the operation. Roughly, the usual time necessary to get a patient in condition for operation is three or four days.

Rest is very necessary as a measure for general conditioning and proper sedation should be given when necessary.

Unless the colon is obstructed or the growth in the colon has caused a perforation of sufficient degree to contraindicate the oral administration of food, the diet is given by mouth; otherwise fluid glucose and saline solution are supplied intravenously. The term applied to this diet is pre-operative residue-free. It consists of dextrin added to strained fruit juice with meals, fruit juice between meals, three times daily, hard candy, one slice of Melba toast, cream of wheat, rice, macaroni, spaghetti, jelly, butter, and coffee or tea. These essentials of the diet are arranged in proportions and individual amounts to suit each case.

It has been shown that anemia is a surgical hazard. Time for pre-operative preparation is too short to resort to measures short of transfusion; sometimes multiple transfusions may be necessary.

The value of the use of intraperitoneal vaccine is a controversial point. The author's rule is that intraperitoneal vaccination is indicated in cases in which intraperitoneal resection has any chance of being the operation of choice after the abdomen is opened.

The difficulties to be encountered in cleansing the colon will be dependent not only on the amount of obstruction present, but also on the coöperation of each patient concerned. The degree of justifiable effort involved in each case will depend on the amount of obstruction present, on its duration, on the presence or absence of barium proximal to the lesion, as well as on the tendency toward or presence of perforation of the colon.

When marked obstruction exists in the colon, the value or harm of the extended use of intubation will be dependent on the competency or incompetency of the ileocecal valve. The warning against the prolonged use of medical intestinal decompression in the presence of obstruction of the large bowel cannot be too strongly stressed.

When an unusual major surgical procedure has been performed on the colon, regardless of the immediate postoperative condition of the patient, on the author's service a transfusion of at least 500 c.cm. of blood is a routine order. In all cases of major surgery of the colon, another routine postoperative order is that of giving concentrated oxygen.

To the surgeon, the worry associated with cases of malignant lesions of the colon begins with the problems of diagnosis and ends, not with death or cure, but with the understanding of the causes of death or of cure, and as a result, the accomplishment of a greater and greater percentage of cures.

Boothby, W. M., Mayo, C. W., and Lovelace, R. W., II.: The Use of Oxygen and Oxygen-Helium, with Special Reference to Surgery. *Surg. Clin. North Am.*, 1940, 20: 1107.

The rapidity with which new therapeutic uses for oxygen and mixtures of oxygen and helium have increased is well illustrated by the fact that during 1938 oxygen was administered to approximately 1,380 patients at the Mayo Clinic, and during 1939, to approximately 2,200. This increase in the use of oxygen has been the result of the proper application of physiological investigations of respiration and circulation as well as of advances in methods of administration.

As recently emphasized by one of us (C.W.M.), oxygen is given most commonly as a last resort in an effort to prevent death from anoxemia, but there is also a large group of cases in which the administration of oxygen, if started early as a prophylactic measure, will result in elevation of the resistance and diminution of complications with a consequent shortening of convalescence. No patient who has received a high concentration of oxygen following extensive major surgical procedures by means of the B.L.B. oxygen-inhalation apparatus has been affected adversely, and for many patients such therapy has been a vital factor in an uninterrupted convalescence.

The early signs of lack of oxygen are an elevation in the pulse rate, cyanosis, and usually a slight increase in pulmonary ventilation. This slight increase in ventilation usually is brought about by a slight increase in the number of breaths per minute with a smaller increase in depth of respiration. Many individuals may become unconscious as a result of anoxemia without a sufficient increase of the pulmonary ventilation to attract the attention of the unobservant. Excess of carbon dioxide, however, causes a marked increase in the depth of respiration as well as in the rate of respiration; the dyspnea so caused is very noticeable.

The effects of lack of oxygen in disease are similar to its effects at high altitudes such as can be reached on high mountains or in modern airplanes. This is a vital problem in the case of pilots of airplanes because even slightly impaired mental and physical function may result in an error in judgment or delay in action that may eventuate in an accident.

In the presence of intestinal obstruction every effort should be made to relieve the gaseous distention and, if possible, to overcome the obstruction before surgical procedures are instituted. Approximately 70 per cent of the gas in the intestine is nitrogen. Whenever 100 per cent oxygen is inspired, the partial pressure of nitrogen in the lungs is reduced quickly to practically zero, from the normal partial pressure of 570 mm. of mercury. As a result the nitrogen in the plasma of the blood diffuses into the alveoli and is then expired. The combination of oxygen and suction has been used in more than 100 cases and has been beneficial in the greater majority as evidenced by relief of distention, nausea, restlessness, decrease in the pulse rate, and concomitant easier respiration. In successful cases a beneficial effect is obtained within from twelve to twenty-four hours.

Burford and Leigh during the past two years have employed oxygen inhalation routinely during spinal anesthesia. None of the patients on the surgical service of one of us (C.W.M.) during the same period has had headaches after extensive operations on the colon or small bowel under spinal anesthesia if he has been given 100 per cent oxygen for from eighteen to thirty-six hours after operation.

Nearly all methods of combating shock that are of proved clinical value are aimed at improving the circulation of the blood and increasing the partial pressure of oxygen in the tissues, especially in the central nervous system. The authors contend, on the basis of frequent clinical observations during the past two years, that the inhalation of 100 per cent oxygen will aid materially each of these well tried methods in attaining its physiological purpose. Every method available should be used in the severe cases; in the milder cases 100 per cent oxygen alone may be sufficient to bring the patient out of shock, especially if administration is started early.

The highest incidence of pulmonary complications occurs after operations in the upper part of the abdomen. Such operations are usually major ones that take some time to perform and subsequently require a comparatively long convalescence. Postoperative atelectasis, infarction, and pneumonia may go on to pulmonary abscess. The treatment of shock associated with pulmonary embolism is the same as that for surgical and traumatic shock. The administration of 100 per cent oxygen is imperative in severe cases in an effort to overcome the anoxemia and break up the vicious circle associated with shock. As soon as a diagnosis of postoperative pneumonia is made, oxygen therapy should be started at a sufficiently high concentration to control the cyanosis and pulse rate.

Because of the relatively increased consumption of oxygen in cases of hyperthyroidism, anoxemia may develop easily and rapidly and tends to lead to serious consequences. When temperature, pulse rate, and oxygen consumption rise postoperatively, the administration of pure oxygen may prevent cardiovascular collapse.

The administration of high concentrations of oxygen has been found valuable, among other conditions, after operations on the thorax or lungs when there is a resultant decrease in vital capacity and often more or less pulmonary congestion, in the presence of traumatic injuries to the thorax after operations on diabetics (especially on patients in the older age group among whom wounds are likely to heal slowly and infections develop), in the presence of extensive trauma of any type, after reduction of an intussuscepted portion of the bowel, and in carbon-monoxide and cyanide poisoning. The therapeutic uses of helium and oxygen mixtures and of oxygen in various types of surgical cases and problems associated with the administration of both oxygen and helium and oxygen are considered in detail. Reference is also made to the need of oxygen at high altitudes and its use in aviation.

In the past two years, by means of our apparatus for the inhalation of oxygen, the authors have administered 100 per cent oxygen to more than 1,800 patients without observing the slightest evidence of pulmonary irritation. Only a few have been given 100 per cent oxygen continuously for more than forty-eight hours, but this high concentration of oxygen has been administered intermittently for several days. They recommend that this length of time be not exceeded and that thereafter the flow of oxygen be so regulated that the patient receives from 50 to 75 per cent oxygen.

Aguilar Alvarez, J. Transpleural Routes of Approach (Vias de acceso transpleurales). *Analecta med.*, 1940, 1: 3.

The author presents a series of illustrations to demonstrate the technique of transpleural approach to the organs located under the left half of the diaphragm, such as the upper third of the stomach, the extremity of the esophagus, the spleen, and the splenic flexure of the colon, which are not sufficiently accessible through the usual incisions. The position of the patient must be such as to afford the greatest facilities to the surgeon.

The site of election at which the incision is to be made is the axis of the ninth rib from the posterior axillary line to the external border of the left rectus muscle and even to the middle line or part of the right rectus muscle. In some cases it will be necessary to resect a portion of the ninth rib or to section adequately the costal cartilages, but in all cases a basic step in the operation is to close off the thoracic cavity by running two parallel lines of sutures through the pleura and diaphragm: the incision to reach the peritoneum is made between these two lines.

Various other incisions have been recommended, such as that starting along the cartilaginous junction of the ribs, running down the lower costal border until it has crossed the mammillary line and then turning upward at a right angle; in this case, the cartilaginous junctions of the eighth, ninth, and tenth ribs anteriorly and the ninth and tenth ribs posteriorly are sectioned to provide the necessary room. Another incision is that of Kirschner's thoracolaparotomy which starts from the middle supraumbilical line in its upper third, approaches the costal border perpendicularly, and follows the seventh intercostal space; the cartilage is then sectioned and the diaphragm opened radially; this gives access to both thoracic and abdominal cavities for mixed cases, but the procedure has a serious prognosis. Kirschner recommends also the same incision for cases in which it is desired to keep the intervention below the pleural sac. After the operation, the various planes that have been sectioned are carefully reconstructed.

The transpleural route is very useful in disorders of the upper third of the stomach and high ulcers of the smaller curvature, in the treatment of cancer which requires total gastrectomy, in diseases of the cardia or of the last portion of the esophagus, in splenectomy with fixed spleen, or in traumatic lesions of this organ which require rapid and sure intervention, such as rupture and wound with severe hemorrhage, and in ulcerating or stenosing processes of the splenic flexure of the colon which do not require colectomy. RICHARD KEMEL, M.D.

Wood, G. O., Mason, M. F., and Blalock, A.: Studies on the Effects of the Inhalation of a High Concentration of Oxygen in Experimental Shock. *Surgery*, 1940, 8: 247.

The effects of the administration of pure oxygen to dogs with mild peripheral circulatory failure produced by hemorrhage, trauma, and the injection of histamine have been studied.

The inhalation of oxygen, under these conditions, results in a considerable increase in the amount of oxygen available to the tissues, as evidenced by a rise in the arterial oxygen content and increase in the venous oxygen content of the blood from various parts of the body. This availability may be further enhanced by concomitant increases in carbon-dioxide tension.

The observations confirm the prevailing impression that inhalation of high concentrations of oxygen exert beneficial effects in the treatment of peripheral circulatory failure. SAMUEL KAHN, M.D.

Weil, P. G., Rose, B., and Browne, J. S. L.: The Reduction of Mortality from Experimental Traumatic Shock with Adrenal Cortical Substances. *Canadian M. Ass. J.*, 1940, 43: 8.

The rôle of the adrenal cortex in the protective mechanism of the organism against a variety of damaging stimuli and noxious agents has been shown by numerous investigators. It has been suggested that since the signs and symptoms of traumatic shock resemble those of adrenal insufficiency, they are possibly due to failure of adrenal cortical function. In human traumatic shock adrenal cortical extract has been recommended as a valuable aid. However, it is difficult to evaluate the reports of its use because of unsatisfactory conditions of test and control. The occurrence of shock is unpredictable; patients, operative procedures, and anesthetics vary, and cortical extracts have usually been used in conjunction with other therapeutic agents.

The authors studied the effects of administration of adrenal cortical extract and desoxycorticosterone acetate (D.C.A.) without other therapy in the prevention of death in rabbits exposed to a lethal shocking stimulus. The experiments were well controlled and 106 animals were used. Both D.C.A. and cortical extracts were given in divided doses before and after the trauma. The results are divided into two series, one receiving cortin and D.C.A. combined, and the other receiving D.C.A. alone. The mortality in the control animals was 62 per cent; in those treated with D.C.A. alone, 46 per cent; and in the series treated with both cortin and D.C.A., 19 per cent. The animals given D.C.A. alone had treatment only before trauma and a dose at the time of injury, whereas those given D.C.A. plus cortin were treated up to six hours after the injury as well. The average survival time was eight hours in the controls and fifteen hours in the group treated with both D.C.A. and cortin.

Evidence of increased adrenal cortical activity following damage to the organism has been reported. These experiments tend to show that if this increased function is anticipated and augmented by the injection of substances having adrenal cortical activity, the mortality from shock after intestinal manipulation is considerably reduced. The administration of adrenal cortical substances before and after operation and in conditions of damage, such as infections, burns, and trauma, may be of clinical importance. JOHN L. LINDQUIST, M.D.

Magladery, J. W., Solandt, D. Y., and Best, C. H.: Serum and Plasma in the Treatment of Hemorrhage in Experimental Animals. *Brit. M. J.*, 1940, 2: 248.

In the treatment of posthemorrhagic shock produced in experimental animals, approximately 40 per cent of the blood removed must be restored to secure recovery. Comparable volumes of serum or plasma produce equally satisfactory results. These findings indicate that under these conditions the volume of the red cells restored to the animal is more important than their oxygen carrying capacity, and that serum and plasma, which can be stored for long periods, are effective substitutes for the treatment of hemorrhage.

The results indicate the importance of administering blood or blood substitutes at a rapid rate (from 50 to 100 c.cm. per min.) and as soon as possible after the hemorrhage. SAMUEL KAHN, M.D.

Irons, E. E., and Apfelbach, C. W.: Aspiration Bronchopneumonia; with Special Reference to Aspiration of Stomach Content. *J. Am. M. Ass.*, 1940, 115: 584.

The authors have described the post-mortem findings in a rather frequent type of bronchopneumonia due to the aspiration of material from a dilated stomach.

The complication is seen in cases of dilatation of the stomach and obstruction of the bowels and in patients who are in coma. It is most frequent following operations in the upper abdomen and on the urinary tract in elderly people.

If the autopsy is performed in the first few hours the characteristic lesions will be found. After that time rapid post-mortem disintegration obscures the findings.

The lungs are increased in weight. There is intense hyperemia of the alveolar capillaries, hemorrhage and edema into the alveoli, and the color of the blood is much darker than that elsewhere in the body.

The bronchial tree shows intense hyperemia, and material in the bronchial tree has the gross characteristics of the material observed in the gastro-intestinal tract. Acute esophagitis and erosions frequently accompany the changes in the lungs.

Associated pathological changes are dilatation of the stomach and small bowel, bowel obstruction, acute generalized peritonitis, and diseases of the brain that have produced coma.

A striking characteristic is that routine cultures from the bronchial tree and from the stomach and intestines reveal that the bacterial flora are almost identical.

If material from a dilated stomach that has no hydrochloric acid is injected into the tracheobronchial tree of a dog the same pathological findings are produced. If hydrochloric acid is present the dog is protected against the development of the lesion.

The microscopic picture of the lesions is distinct and characteristic and is different from those of other types of pneumonia.

Clinically, the condition is a terminal event in a fatal disease, but not infrequently its development determines the issue and many fatalities can be averted. It is undoubtedly of less frequent occurrence in those individuals whose gastro-intestinal contents are continuously aspirated through an intranasal tube. JULIAN A. MOORE, M.D.

Niemi, T.: The Erythrocytic-Sedimentation Reaction in Cases of Embolism, Thrombosis, and Cerebral Hemorrhage, as well as in Some Other Vascular Diseases (Die Senkungsreaktion der roten Blutkoerperchen bei Embolien, Thrombosen und Gehirnblutungen, sowie einigen anderen Gefaesserkrankungen). *Acta med. Scand.*, 1940, Supp. 111.

This monograph begins with a review of the literature which brings to light the various discrepancies and views on the questions herein involved. Before taking up what he denotes his own researches, the author attempts to solve, by a series of preliminary studies, the question of whether advancing years and their common sequelæ, such as generalized arteriosclerosis or sclerosis cerebri, would tend to so affect the sedimentation readings as to hinder the establishment of a satisfactory norm in aging patients. However, extensive observations on 167 of such individuals seemed to establish as a fact that, with the exception of a certain lability in the reaction in the aged and the exception of 9 individuals in the senile dementia group, no specific effect from these conditions was noticeable.

Because of the close relationship to the author's main study, control studies were also conducted on 38 patients with intermittent claudication, again with negative results. However, in 17 instances of endarteritis obliterans, the more severe and long-continued circulatory disturbance apparently proved capable of hastening the sedimentation rate, unless the onset was so gradual (one-third of the cases) that it permitted adequate restitution on the part of the collateral circulatory apparatus.

The author's own studies represent an effort to gain a more comprehensive understanding of the nature of the erythrocytic sedimentation mechanism by supplementing those aspects of the problem which have up to the present time been inadequately treated by other authors, instead of a review of the entire field. The material here subjected to scrutiny by the Westergreen method comprised nearly 300 cases, collected from hospitals in Germany, Austria, and Finland, which ranged in severity from the mildest transient (spastic) manifestations of intermittent claudication to the extensive findings of encephalomalacia at autopsy.

The author's first efforts were directed toward ascertaining whether, and to what degree, the sedimentation response of infarct elsewhere in the body corresponds to its classical picture as seen in cardiac infarction. In 3 renal, and 2 splenic infarcts the typical response was obtained, this consisting of an acceleration in erythrocytic sedimentation which was more or less abrupt in accordance with the acuteness and severity of the circulatory insult. At times, beginning on the day following the accident, the reaction reached its acme anywhere within three weeks, and then, unrelated to, and generally outlasting, fever and leucocytosis, the reaction in each case subsided as though in accord with the completion of the resorption of the infarcted (necrotic) tissues. Ten cases of pulmonary infarction likewise afforded typical reactions, the degree being generally pronounced, at least as pronounced as one would expect from the amount of necrosis present. In the 10 patients in whom infarction could be diagnosed in the extremities, the response was almost uniformly pronounced; in 2 cases in which sedimentation was already accelerated this assumed an even more intense character. In 9 patients with arterial thrombosis of the extremities the reaction was moderately positive, and an even more strongly

positive response was obtained in 3 of the 4 patients in whom a diagnosis of venous thrombosis of the extremities was made; in 2 of the patients of this last group, the thrombotic process was engrafted, with a marked change in the Westergreen reading, and beginning morbidity. This last group is especially interesting as it suggests the possibility of a diagnostic aid in the recognition of deep-lying venous thromboses.

The remaining 250 cases comprised the group of circulatory accidents to the brain (apoplexia cerebri). They are classified as embolic (13 cases), thrombotic (11 cases), and cerebral hemorrhage (227 cases). Only about half the embolic cases exhibited acceleration, and this of moderate degree only. On the other hand only 1 of the thrombotic cases showed normal readings. Therefore, these two groups, like the circulatory disturbances of the extremities, depicted the distinction between transient episodes of vascular spasm and the more enduring thrombotic effects.

The remaining case reports, with the exception of 10 in which cases the cause of the cerebral disturbance could not be determined, had to do with the manifestations of cerebral hemorrhage or hemorrhagic sequelæ. The majority of 22 patients, in whom the symptoms were meager and soon disappeared without sequelæ, evidenced normal readings. In the other groups with progressively severe symptomatology and sequelæ, in which not only extravasation of blood, but also some destruction of tissue (necrosis) might be expected, the Westergreen test responded with an acceleration which was more precocious and more intense presumably as the circulatory insult was increased. In 1 instance the patient entered the hospital with minimal symptoms of cerebral hemorrhage, with little effect on the sedimentation rate, but five days later he suffered a severe cerebral attack, the sedimentation readings this time reaching high values. In every patient who survived, however, the values began to recede after a month or so, so that even in the severe, incurable cases with subsequent permanent invalidism, the reaction a year or so later was always normal.

JOHN W. BRENNAN, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Cohen, S. M.: Experience in the Treatment of War Burns. *Brit. M. J.*, 1940, 2: 251.

Burns are one of the most important of air-raid casualty injuries. From the author's experience after treating 70 cases of burns, one lesson has stood out clearly—the necessity for, and value of a prepared routine of treatment. Instructions should be clear and definite because the after-care of these patients must be left to the nursing staff. In the majority of cases both hands are burned and the eyes are closed and it is a mistake to fill a ward with burn cases only because the demand on the nursing staff is too heavy. The responsibility of these cases should be in the hands of a surgeon who should guide the treatment and often avail himself of the aid of other specialists, as ophthalmologists and dermatologists.

The soldier is a "fit" patient, but often by the time treatment is started these patients are exhausted. Sleep and rest are as important as operation. As a routine, morphine in large doses, ⅓ gr., should be given immediately and often when necessary. In the treatment of a large number of casualties at once it was difficult to judge how ill a burn patient was; blood-pressure readings and frequent hemoglobin determinations were not practical. Clinical signs alone had to serve as a guide to the condition of the patient, and of these the pulse was the most reliable. In only 2 cases was it possible to give plasma transfusions. For those patients who were cold, hot water bottles in large numbers sufficed, or hot strong coffee per rectum proved satisfactory.

Most of these burn cases had an immediate application of tannic acid either in solution or as a jelly, and this is unquestionably the method of choice. Every patient was cleaned in the theater as soon as his condition permitted. Many surgeons are reluctant to clean burns admitted late, but the general condition in no way deteriorated with this cleaning nor did the cleaning precipitate severe sepsis or septicemia. All of these patients had received their burns at least twenty-four hours before admission and the majority three or four days previously. No case was "too late" for full treatment. Fortunately, in the majority of these cases the burns were not deep.

Intravenous anesthesia was used to spare the patient the unpleasantness and difficulties of induction. It was necessary to continue with gas in most cases, and the mask was applied over several layers of sterile gauze.

With arms, face, and chest all burned, the work of cleansing may be expedited by a nurse or a second doctor cleaning at the same time. The importance of gentleness in cleaning such cases is obvious. Weak ether, soap, and water were used in all these cases, and this method of washing—not scrubbing—will merely remove the débris and add nothing to the damage. The region surrounding the burn was washed and prepared as if for operation. In all face and forehead burns the hair was shaved well back under the anesthetic. The débris, the dead skin, and all overlying blisters are removed.

An immediate tan is undoubtedly of great value, and after the cleansing, the solutions, 5 per cent tannic acid and 10 per cent silver nitrate, are kept separate and are dabbed on the cleansed area by separate gauze swabs. On the face a little petroleum jelly is first applied to the eyelids, and if two pieces of wool are held firmly over them, there is no danger of the solution running into the eyes. It has been said that there is some danger of tannic acid causing gangrene of the fingers, but in the cases in this series in which the tips of some fingers sloughed the

gangrene was primarily due to the burn and was anticipated at the time of the primary treatment.

As a routine the burned hands and forearms were splinted with a padded wire splint with a pad of wool for the palm and gauze between the fingers. In bed, the raising of the splinted arms on a sloping pillow greatly assisted in the reduction of the local edema. This maintains the wound at rest; it is so often forgotten that burns are wounds and must be treated as such. The face and neck should not be bandaged, but sterile towels should be placed under the head and chin. The edges of the burn were painted daily with 1 per cent brilliant green to avoid infection.

The eyes require much care. The excessive secretion is wiped away several times a day, and a few drops of sterile liquid paraffin are inserted. Only 1 patient developed a small corneal ulcer.

Chemotherapy was employed as a routine. Sulfanilamide was given every four hours for ninety-six hours—a total of 19.5 gm. By this method inadvertent overdosage was avoided. With this sulfanilamide dosage there were no complications.

A high protein and high vitamin diet is important. Much protein has been lost via the serum, and milk supplies protein in the most abundant manner.

The above instructions were summarized for each ward in a brief, concise manner.

The limbs are maintained splinted for a week when the scabs will have begun to lift. If healing has been maintained the hands and fingers come out of the splint, a sterile dressing is lightly applied over the tan and active movements are started.

In deeper burns granulation tissue is inevitable, and there will be pus under the tan, but this is no indication for its removal. No further dressing was done in these cases until the fourteenth day when the tan if already lifted was removed. Gauze with vaseline is applied and left another fourteen days. For deep burns it cannot be too strongly emphasized that to prevent scarring contractures skin grafting at the earliest possible moment after the sloughs have separated is advisable. Tight splints will not prevent contractures; often they favor them.

The use of plaster for the limb in an early burn was considered, but the extensive edema so characteristic of burns obviously limits its employment. In the later treatment of the deeper severe burn cases the plaster proved of great value; it was applied fourteen days after the burn. Over a vaseline dressing and one layer of sterile plaster wool the forearms and hands were encased in plaster. The improvement was immediate, and all patients were comfortable. The plasters were changed at fourteen-day intervals. In those unhealed at the end of six weeks, skin grafting was immediately done after removal of the pus-soaked plaster.

In this series of 70 burns, there were no deaths in 37 cases treated as outlined and only 2 deaths in the 33 cases which had been cleaned and treated before admission by either methyl-violet or tannic solution.

HARVEY S. ALLEN, M.D.

Hodgson, A. R., and McKee, G. K.: The Surgical Treatment of Air-Raid Casualties. A Review of 12 Cases. *Brit. M. J.*, 1940, 2: 147.

This report is given in a preliminary stage because of several important points brought out regarding the initial treatment of air-raid casualties. Twelve cases are reviewed which were dealt with by one team, consisting of 2 surgeons, 2 anesthetists, 1 sister, and 3 nurses. The injuries were caused by high-explosive bombs and many of them were multiple, there being 6 compound fractures. All but 3 of the conditions were severe. Head, chest, and abdominal wounds are not included. There were no deaths and only 1 amputation. The time consumed in the performance of all the operations was four hours, an average of forty minutes for each one. With further organization this period could, no doubt, be shortened. Two tables were used in the same theater.

A separate history of each case is given in some detail, and these histories are followed by a short discussion of problems and innovations in wound treatment. The routine followed in these cases is summarized as follows:

Shock. The patients were put to bed with hot-water bottles and blankets, and the foot of the bed was raised; morphine (if not already administered) and 2,000 units of tetanus antitoxic serum were given. One of the surgeons then went the rounds of the ward, making a list of cases for operation. He saw that patients with tourniquets were dealt with fairly quickly and that patients in the extreme stages of shock were left until they recovered. Patients with severe injuries and a moderate degree of shock were operated on as soon as possible. As there were many in this last category the time element was important. Plasma transfusions were given in the cases of the more severely shocked patients.

Operation. All patients received a general anesthetic, ether being given by the open method. The clothing of each patient was cut off and the wound exposed; a sterile swab was placed over the wound itself and the surrounding skin was then cleansed with ether soap, and shaved. The surgeon now scrubbed up, removed any gross contamination from the wound with forceps, and applied first to the wound and then to the surrounding skin a solution of 50 per cent dettol in spirit, colored with methylene blue. The skin edges, and all of the deeper structures that were colored blue and were readily accessible were excised. Deep perforating tracks, which could not be opened up because of the danger of further injury to important structures, were carefully explored for pieces of bomb casing; the whole wound, and especially these tracks, were then packed with sulfanilamide powder.

After-treatment. Upon returning the patient to the ward the treatment for shock was continued. Sulfanilamide was given by mouth (15 gr. every four hours) as soon as the patient could take it, and was continued for from twenty-four to forty-eight hours, according to the temperature chart. Wound dress-

ing was avoided as far as possible, the main indication for inspection of the wound being a slight rise in temperature accompanied by a rapid rise in pulse rate. A musty smell from the dressing is an additional factor which should arouse suspicion of anaerobic infection. SAMUEL H. KLEIN, M.D.

Walters, W., and Magath, T. B.: Operative and Postoperative Infections, with Special Reference to Air-Borne Bacterial Contamination. *Ann. Surg.*, 1940, 112: 271.

The fundamental principles underlying the application of bacteriology to surgery were early recognized as basic. Refinements and modernization keep these principles constantly before the operating-room personnel and tend to make for more accurate and more careful operative technique in the performance of the necessary surgical procedure with a minimum of trauma and without undue prolongation of the operation.

The contamination of wounds may result by the direct introduction of air-borne bacteria into the wound. It is obvious that the condition of the wound will have a profound effect on the development of these contaminating agents. Tissues from which the blood supply has been cut off or which have been devitalized by trauma offer an excellent medium for the development of bacteria; live, normal tissue is by nature resistant. For this reason pieces of tissue which are cut off from a blood supply should be removed. If air spaces are present in wounds, either horizontally or vertically, they offer opportunity for the accumulation of serum and exudates which furnish an excellent bacterial medium. Wounds which are dry usually do not permit the development of bacteria as rapidly as wounds which are wet; hence, oozing should always be thoroughly controlled.

Aside from these items, which are entirely in the hands of the surgeon, there is another group of important sources of contamination. Meleney, in reporting a nine-year study of infection in clean operative wounds, listed the possible sources of contamination in the following order: (a) the nose and throat of the operating personnel; (b) the hands of the operating personnel; (c) the skin of the patient; (d) the air of the operating room; and (e) the instruments and materials used in the operation.

In 1930, Walker, in studying the incidence of hemolytic streptococcus infections, was convinced that direct contamination of the wounds occurred from the nose and throat of the operating personnel. Hart and Schiebel believe that there is a definite correlation between the type and number of organisms found in the air of a given room and in the noses and throats of a group of regular occupants of that room. These authors said that "the number and type of colonies cultured from material taken from the nose and throat seem to parallel more nearly the number and type of colonies cultured from sediment from the air."

Devenish and Miles, who studied various sources of contamination of wounds by the staphylococcus aureus, placed great emphasis on the rôle played by direct contamination of the wound through needle holes in punctured rubber gloves. These observers found that the incidence of puncture in 6,585 patched and unpatched gloves was 24 per cent, while in a second and third series of tests of unpatched gloves worn by surgeons, chief assistants, and instrument nurses, 14.5 per cent were found to be punctured.

By no process yet known is it possible to sterilize the skin of the patient completely throughout the layers which are cut by the surgeon's knife. The antiseptic should kill bacteria in a reasonably short time; it should not be neutralized by the presence of small amounts of serum, fats, soaps, or oils; and its effect should last at least throughout the operation and preferably for several hours after the closure of the wound. It should not be an irritant to the skin. After many experiments it was decided that the antiseptic which most nearly fulfills the requirements at the present time is tincture of merthiolate.

In 1932, Dandy called attention to the importance of more adequate sterilization in hospitals. Unless tests are made at frequent intervals to determine the efficacy of the method of sterilization used for autoclaved materials, such materials offer a possible source of wound infection.

Since attention has recently been given to air conditioning it is not peculiar that attention should be directed to the possibility of air-borne infection in the operating room. Sufficient evidence has been brought forward to indicate that the bacteria in the nose and throat of the operating team and of the gallery have distinct possibilities in regard to the infection of wounds. It is obligatory upon the individuals to cover the oral and nasal orifices with adequate masks. The operating room should be stripped of all unnecessary equipment and it should be kept scrupulously clean. Bacteria settle from the upper to lower strata and eventually to the floor. Bacteria which originate in the nose and throat are not often found above the six-foot level and they filter down to the floor. In order to prevent the falling bacteria, which originate in the gallery, from reaching the operating room some surgeons have had canopies built over the operating table. The authors have for years had canopies built over the instrument tables, and test plates placed on top of and under the canopy clearly reveal the fact that the canopy offers an enormous protection to the instruments. Tests which the authors have performed with the ultraviolet light have indicated that, unless the bacteria are exposed for long periods of time, at close range, to the light, and then without any coating of serum, gelatin, or agar, there is little or no killing to be demonstrated. More or less dry bacteria, exposed in confined regions, are readily killed.

There is no doubt that the bacterial content of air in an operating room increases with time and the number of persons present, yet no special correlation can be demonstrated between the number of infections and the order of operations performed in any

given room. Even yet the exact source of these bacteria or their significance in regard to wound infection is not known. It is evident, however, that direct introduction of bacteria into a wound from a non-sterile instrument or material, the excretions from noses and mouths of the persons close to the wound, or sweat from the hands of the operating team through punctures of gloves, is of tremendous significance and an effort should be made first to correct these conditions before turning to the sterilizing of the air of the room. If some effort is indicated in this regard a system of air filtration should be tried, but one may not expect to reduce operating-room infections greatly until after the first enumerated sources of infection are controlled.

Firor, W. M.: The Intrathecal Administration of Tetanus Antitoxin. *Arch. Surg.*, 1940, 41: 299.

The author has attempted to evaluate the relative value of the intrathecal and the intravenous administration of antitoxin in the treatment of general tetanus.

Healthy dogs were given approximately two lethal doses of tetanus toxin filtrate intravenously. Fifty-three hours later the animals were divided into groups according to the severity of their symptoms and were given 680 American units of tetanus antitoxin per kilogram, either intravenously or intracisternally.

Intracisternal administration of the antitoxin gave better results than intravenous administration in dogs that were suffering from early, mild, or moderately severe tetanus. In dogs with severe tetanus this difference was of a smaller degree.

Among 70 dogs that received the antitoxin by the intracisternal route the mortality was 27 per cent; among 30 dogs that were treated by lumbar injection the mortality was 37 per cent; and in 20 dogs that were given antitoxin intravenously and horse serum intracisternally the mortality was 45 per cent. Among 65 animals that received only intravenous injections of the antitoxin the mortality was 75 per cent. All control animals that received no treatment with antitoxin died from tetanus.

Although these figures alone do not warrant the use of intracisternal injection for patients, they furnish conclusive evidence that the mortality among dogs with general tetanus is lowest when the antitoxin is given by the intracisternal method.

EDWARD W. GIBBS, M.D.

Chain, E., Florey, H. W., Gardner, A. D., Heatley, N. G., and Others: Penicillin as a Chemotherapeutic Agent. *Lancet*, 1940, 239: 226.

It has been noted by Fleming that a mold produced a substance which inhibited the growth, in particular, of the staphylococcus, streptococcus, gonococcus, meningococcus, and corynebacterium diphtheriæ, but not of the bacillus coli, haemophilus influenzæ, salmonella typhi, bacillus proteus, or vibrio choleræ. A broth containing this substance is called "penicillin."

The results of experiments done on mice, rats, and cats are clear-cut, and show that penicillin is active *in vivo* against at least three of the organisms inhibited *in vitro*. It is a reasonable hope that all organisms inhibited in high dilution *in vitro* will also be affected *in vivo*.

Penicillin does not appear to be related to any chemotherapeutic substance now in use; it is particularly remarkable for its activity against the anaerobic organisms associated with gas gangrene.

SAMUEL KAHN, M.D.

ANESTHESIA

Adams, R. C., and Lundy, J. S.: Factors Influencing the Choice of the Anesthetic Agent and Some Suggestions on Anesthetic Technique. *Surg. Clin. North Am.*, 1940, 20: 915.

Perhaps the most valuable asset of a thoroughly trained anesthetist is his ability to select anesthetic agents and methods which are most suited to each individual patient. As a result of his judgment, both the surgeon and the patient are benefited.

An anesthetic must be chosen which will have the least deleterious effect on the patient, but which, at the same time, will be adequate for the anticipated operation. Frequently, the choice involves the combination of two or more methods, any one of which used alone would be inadequate.

Among other factors regulating the choice of the anesthetic to be employed are the age of the patient; the degree of debility or toxicity present; the site, nature, and proposed duration of the operation; and the hazard of anesthetic explosion. The emotional stability of the patient is another important factor; this can now be controlled by preliminary medication. Sometimes patients have preferences as to the anesthetic, and if the anesthetic they wish is suitable for them, it is well, if possible, to yield to their wishes in this regard. Intravenous anesthesia has been used to advantage for induction prior and supplementary to inhalation, local, and spinal anesthesia. The patient's muscular development and habits and mode of life all influence the choice and course of the anesthetic to be used. Patients suffering from chronic alcoholism are notorious for tolerating anesthetics poorly.

Each agent and method has advantages and disadvantages: among the gaseous anesthetic agents, nitrous oxide with oxygen is non-explosive and non-irritating to the lungs, but it has been found to be inadequate for major surgical procedures. Ethylene, although a somewhat more potent agent than nitrous oxide with oxygen, still falls short of being a perfect anesthetic, and it is inflammable in anesthetic concentrations. Cyclopropane, a potent anesthetic agent, is almost non-irritating to the lungs and exerts a minimal effect on the chemistry of the blood; it is also explosive in anesthetic concentrations and may produce grave cardiac irregularities. This agent may be dangerous in the hands of those untrained in its use. The potency and toxicity of ethyl

chloride and divinyl ether inhibit the field of their usefulness in the hands of untrained anesthetists.

Ether remains the safest of the volatile anesthetic agents and the safest inhalation anesthetic agent for general use. Used alone, it produces adequate anesthesia for many types of surgical procedures. Despite its outstanding usefulness, ether may produce many deleterious changes in the function of the blood and tissues: it is irritating to the respiratory tract and it may be both inflammable and explosive.

Regional anesthesia could be employed to advantage more often than it is, but occasionally it must be supplemented to advantage by some other method, especially for nervous patients. Spinal anesthesia is contraindicated for patients who are markedly debilitated, especially if the hemoglobin is below 50 per cent; spinal anesthesia is also contraindicated for some patients who have hypotension or lesions of the spinal cord, and for nervous individuals. Many physicians do not favor spinal anesthesia for extensive operations in the upper portion of the abdomen. Rectal anesthesia is usually safe for purposes of basal narcosis. Intravenous anesthesia has recently attained considerable prominence and its field of usefulness continues to increase. At this time only two agents possess exceptional merit, namely, pentothal sodium and evipal sodium. Among the advantages of intravenous anesthesia are the rapidity of induction, the short period of recovery and the fact that postanesthetic complications, especially nausea and vomiting, are rare. Intravenous anesthesia is not always a suitable method for long or extensive operative procedures and there are types of surgical procedures in which it is contraindicated.

In selecting the anesthetic of choice, one of the first things to consider is the type and amount of the agents to be used in preliminary medication. Usual preliminary medication consists of the administration of a barbiturate by mouth or rectum, or intravenously, and of morphine and atropine by hypodermic injection.

The dosage required to bring about this end varies with the individual, his metabolic rate, age and physical condition, emotional tone, and so forth. The use of morphine is usually contraindicated for a younger child because its respiration is depressed easily, even after small doses of the drug.

The site of the operation also is an important factor in choosing the most suitable type of anesthetic to be used. In some fields the choice may be broad, whereas in others, the choice is narrowed to one or two methods. Some of the choices of anesthesia which may be made in the various fields of surgery are given in the complete paper. Certain systemic diseases markedly influence the choice of anesthetic. One of these is diabetes mellitus.

Koontz, A. R., ad Shackelford, R. T.: The Effects of Ether Anesthesia on Anaphylaxis. *Anes. & Anal.*, 1940, 19: 196.

The authors carried out a series of experiments on guinea pigs in an attempt to decide whether ether anesthesia would or would not prevent anaphylactic reactions. After using various methods for providing shocking injections, it was finally decided that the best results were obtained by using guinea pigs weighing not less than 650 gm. These were sensitized with 1 c.cm. of horse serum given subcutaneously and three weeks later 2 c.cm. of horse serum were injected into the jugular vein to provoke shock. A striking difference in mortality was noted between those animals which had and those which had not been etherized.

From these experiments, it was concluded that ether anesthesia gave great protection against anaphylactic shock in guinea pigs. However, the authors do not feel justified in stating that this protection is absolute.

The evidence as to whether this applies to human beings is not convincing as yet. During the World War, it was customary to administer serum to wounded soldiers while under ether anesthesia without the usual precautions against anaphylactic shock. The authors have searched the Surgeon-General's reports and have questioned men in positions of authority at that time and have found no evidence of unfortunate results. Only 1 case could be found in the literature in which there was a fatal anaphylactic reaction while the patient was under ether anesthesia. Nevertheless, it is concluded that the evidence is not yet sufficient to justify the elimination of the sensitivity test before administration of a serum to a patient under anesthesia.

SAMUEL H. KLEIN, M.D.

Rivett, L. C., and Quayle, G.: A Method of Administering Continuous Intravenous Anesthesia for Abdominal Surgery. *Proc. Roy. Soc. Med.*, Lond., 1940, 33: 631.

The authors describe an apparatus for the continuous administration of intravenous anesthesia. This consists of two reservoirs, one containing a 2 per cent solution of pentothal and the other 5 per cent dextrose in normal saline solution, connected to the intravenous needle by a Y-tube.

Throughout the course of the operation, saline solution and dextrose are kept dripping to ensure that the needle is always patent. If, at any stage of the operation, the patient shows signs of shock, the rate of flow can be increased, and, if considered necessary, the apparatus can remain attached to the arm during the patient's return to the ward. In the event of severe hemorrhage, blood could be substituted for the saline solution.

Because of the dilution of the pentothal down to a 2 per cent solution, the amount given can be delicately controlled. From 2 to 10 c.cm. of this solution are usually required every two to ten minutes.

Rivett has had a very large experience with major pelvic operations under intravenous pentothal, without any inhalation anesthetic whatsoever, and he can definitely say that there are certain great advantages. Perhaps the first of these is the shallow respiration which accompanies anesthesia with intra-

venous barbiturates—a very great advantage in pelvic surgery, as the intestines gravitate into the upper abdomen when the patient is in the Trendelenburg position, which gives excellent access to the pelvic organs.

He has found that even light anesthesia gives very good relaxation of the abdominal muscles, and if a little deeper anesthesia be required, it is easily and rapidly produced.

It does not appear to be easy for the anesthetist to know with certainty the depth of anesthesia, and at one time, as a routine, he tested the patient's insensibility by pricking with a scalpel. The more experienced the anesthetist, the less necessity there is for this procedure. It is a minor drawback which is overcome with experience. The second drawback is the occasional difficulty the anesthetist experiences in finding a vein and in keeping the needle in the vein when found. The only other drawback the author has ever seen has been due to some of the solution's leaking into the subcutaneous tissues, which caused actual ulceration. Ulcers produced in this way may take longer to heal than the major operation incision itself.

The anesthesia does not seem to be as deep as full surgical ether anesthesia. Therefore, the surgeon must be gentle in all his manipulations. Sudden and violent traction on any organ may produce sufficient stimulus to break through the anesthesia and cause the patient to move. If anything, this is an advantage, as the author is quite convinced that rough handling of the uterus, ovaries, or intestines is a very great factor in producing shock. Rivett is convinced that pentothal is the anesthetic of choice, and that it is the least dangerous of all anesthetics.

SAMUEL H. KLEIN, M.D.

Palma, E. C., Alonso, J., and Pérez-Fontana, M.: Segmental Peridural Anesthesia (Anestesia peridural segmentaria). *Bol. Soc. de cirug. de Rosario*, 1939, 10: 399.

The authors recall the anatomy of the peridural space and also the experiments on cadavers and on dogs which have shown that the degree of diffusion of liquids injected in this space is inversely related to their viscosity and depends especially on gravity and, therefore, on the position of the patient. They point out that, as the posterior longitudinal venous plexuses occupy a paramedian position and as the posterior transverse venous plexuses are found in front of the vertebral laminæ and not at the level of the yellow ligaments in the lumbar and lower dorsal regions, there is no danger of puncturing them when a needle is introduced in the middle line between the vertebræ. It has been established that the pressure in the peridural space is negative, and this fact may be used to determine the penetration of the tip of the needle into that space. The authors have used segmental peridural anesthesia in 64 cases for interventions on the abdomen, the perineum, and the lower extremities. Their technique included the following points:

The original solution used has been gradually improved and the authors now employ a mixture of novocaine (1.5 per cent) and pantocaine (1 per thousand) in double distilled water. The needle is 12 cm. long, has a short bevel to avoid injury to the dura mater, and is provided with a mandrel having the same bevel as the needle. The needle should have a guard at its posterior end to facilitate its manipulation, and the guard should have a depression which communicates with the lumen of the needle and into which a drop of the anesthetic solution can be deposited to be aspirated into the lumen at the moment the needle penetrates into the peridural space (sign of Gutierrez). The patient is placed in lateral decubitus, or, preferably, is seated, but always with the spine flexed. The site of puncture will depend on the level of the desired anesthesia: puncture is made between the tenth and twelfth dorsal vertebræ for interventions on the upper abdomen, between the twelfth dorsal and the second lumbar vertebræ for those on the lower abdomen, and between the third and fifth lumbar vertebræ for those on the lower extremities. The patient is given an injection of morphine hydrochloride (0.01 gm.) one hour before the intervention. After previous infiltration of the site and course of the puncture with a 0.5 per cent solution of novocaine, the puncture is made exactly in the median line and the direct procedure is used, the injection being stopped as soon as the yellow ligament has been pierced. Various signs help in deciding when the peridural space is reached: the sensation of unequal resistance, the absence of the issue of cerebrospinal fluid after the yellow ligament has been passed, Dogliotti's sign which consists of the difference in pressure needed to inject the solution, the impossibility of aspirating cerebrospinal fluid, Gutierrez' drop sign, Mondadori's sign (an injection of double distilled water in the peridural space causing intense abdominal pain), and the temperature of the backflow drops. If there is a lack of paresthesia or complete anesthesia and paralysis of the lower extremities ten minutes after the injection of 5 c.cm. of the anesthetic solution the needle was not in the subarachnoid space. Great caution is recommended in the administration of the remaining amount of the solution, the pulse and the arterial pressure as well as the general condition of the patient serving as continuous controls; 10 c.cm. are injected slowly every five minutes. This does not cause any loss of time as peridural anesthesia needs from twenty to twenty-five minutes to develop its full effect.

The authors have obtained 54 good anesthesias in 64 injections. In 3 cases, local anesthesia was needed to close the abdominal wound and in 1 case it was necessary to anesthetize the mesentery. In 5 cases, the anesthesia was poor and was completed with ether. Slight disturbances due to anesthesia of the sympathetic occur regularly and are prevented by a simultaneous injection of ephedrine. A tendency toward tachycardia is frequently observed.

The anesthesia lasts from seventy to one hundred minutes and the postanesthetic course is excellent.

Peridural anesthesia is contra-indicated in patients who present local anatomical changes which impede puncture under good conditions and in those with hypotension, shock, marked anemia, and cardiovascular decompensation. It can be used in all surgical conditions of the lower extremities, the perineum, the pelvis, the urinary tract, and the abdomen, in which local anesthesia cannot be employed.

RICHARD KEMEL, M.D.

Peirson, E. L., and Twomey, C. F.: Neurogenic Dysfunction of the Bladder Due to Spinal Anesthesia. *New England J. Med.*, 1940, 223: 171.

Nerve damage resulting from spinal anesthesia is fortunately a rare complication, but apparently it is much more common than is generally recognized. Of the various sequelæ of spinal anesthesia which have been reported, paralysis of the bladder appears to be one of the most serious.

It is interesting that the neurological lesions resulting from spinal anesthesia are extremely varied, both in character and in severity. Loeser reports 5 cases of peripheral neuritis affecting isolated peripheral nerves, which he had seen in one year. These cases followed the administration of small doses of procaine. Likewise, cases of ocular paralysis lasting several weeks or more have been reported. Smith saw a case of incomplete transverse myelitis following the use of spinocaine. Hyslop reports a case of aseptic meningitis resulting from the administration of 200 mgm. of nupercaine. One of the authors (E.L.P.) has seen a similar case following the administration of 150 mgm. of novocaine. Ferguson and Watkins report 14 cases of injury to the cauda equina which they had personally observed, and have also collected 16 other cases from the literature. In these, the most striking and most serious symptom was immediate retention of the urine, followed at a later period by incontinence. The patients continued to have residual urine and difficulty in urinating for periods varying from several weeks to more than two years.

The authors report a case of a sixty-year-old man who was entirely well until an appendectomy was performed under spinal anesthesia. Following this operation, he had complete retention of urine for two and one-half months. Since a complete study of the case failed to show any cause for this retention, it was assumed that the bladder dysfunction was due to nerve injury as a result of the spinal anesthesia. The retention of urine was relieved following a presacral nerve resection. This was done after three weeks of preliminary treatment for urinary sepsis by catheter drainage with a small Foley catheter, connected so that the drainage system was kept closed. Irrigation was performed without disconnecting or opening the system. The patient has remained well for seven months following his discharge from the hospital.

The literature on this subject is reviewed, and it is suggested that minor degrees of nerve damage are more generally a result of spinal anesthesia than is usually thought to be the case.

JOHN E. KIRKPATRICK, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Schwartz, C. W.: Cranial Osteomas; From a Roentgenological Viewpoint. *Am. J. Roentgenol.*, 1940, 44: 188.

A group of 48 cases of cranial osteomas was reviewed. Sixty per cent of them were frontoethmoidal in origin, half of these originating wholly within the frontal sinuses and half in the vertical portion of the frontal bone. Thirteen per cent originated in the orbito-ethmoidal region and 13 per cent in the parietal bones. Six per cent involved the petrous portions of the temporal bones and 4 per cent the squamous portions of the temporal bones. Four per cent were found in the occipital region.

Usually osteomas arise from the surface of the bone and can be designated as exostotic, but occasionally they originate within the bone and are enostotic. Usually the osteomas of the frontal region and of the facial bones are of the enostotic variety. This is true also of the osteomas which involve the bones of the cranial vault. The calvarial osteomas usually originate in the diploë and involve one or both adjacent tables.

The etiology of osteomas is unknown. Trauma or infection may at times stimulate an osteoma to accelerate its normally slow growth. A year or two may intervene between the trauma and the increase in size of the tumor. Cranial osteomas are more prevalent in males than in females but this may be due to the greater frequency of examination of the male skull, which is more subject to accidental trauma.

Intracranial and particularly frontal osteomas may be associated with mucoceles. When such an association occurs, the osteoma may extend intracranially and puncture a lateral ventricle. Surgical removal is the only known way to stop such progress. Osteomas may invade the orbits and when they do there is usually some exophthalmos of a non-pulsating type. Such orbital tumors are chiefly ethmoidal in origin and occasionally pedunculated.

Many cranial osteomas are asymptomatic and this is true particularly of the tumors found in the frontal sinuses. If such an asymptomatic osteoma is discovered, the patient should be examined every six or eight months in order to determine whether there is any increase in size. If an increase in size occurs, the osteoma should be removed. Osteomas are more likely to grow rapidly in young people. The spongious type of tumor will enlarge more rapidly than one composed of dense sclerosing bone.

The author discusses in detail the differential diagnosis. A number of excellent illustrations accompany the article, two of which are here reproduced. Figure 1 illustrates an osteoma of the frontal bone and Figure 2 an osteoma of the petrous portion of the temporal bone. HAROLD C. OCHSNER, M.D.

Fig. 1. An osteoma of the frontal bone. The frontoethmoidal region is a common site of election for these tumors.

Fig. 2. An osteoma of the petrous portion of the temporal bone. It is of the combined dense and spongy type.

Sweany, H. C.: On the Nature of Calcified Lesions; with Reference to Those in the Spleen. *Am. J. Roentgenol.*, 1940, 44: 209.

A series of 20 tuberculous patients, 16 of whom were adults and 4 children, has been studied to determine the evolution of calcified lesions, principally in the spleen. The ages of the lesions in the lung, lymph nodes, and spleen corresponded in 16; corresponding lesions were found in the mesentery and spleen in 1 patient, and in the lungs, lymph nodes, liver, and spleen in 1; but in 2 there was no agreement of ages of the respective lesions.

In his studies the author has found the evidence to be in favor of tuberculosis as the cause of calcifications of the spleen. The lesions are within the parenchyma of the spleen, and not in the splenic veins at the periphery, or in the trabeculæ, where phleboliths are wont to appear. Most of the calcifications are multiple and appear to be a result of hematogenous dissemination. Many of the lesions in each group of calcification are from two to three times the size of the average veins, and are therefore too large to represent phleboliths. They are associated with and correspond roughly in age characteristics to a primary tuberculous lesion elsewhere and would therefore correspond to the hematogenous phase of the primary infection.

The author believes that to insure greater accuracy the roentgenological diagnosis of calcifications in the spleen should be made only on the basis of good stereoroentgenograms. A similar examination should be made of the chest, neck, and lower abdomen for calcification of the tubercles. The presence of calcified tubercles in the spleen has in itself little clinical significance, but it shows that primary tuberculosis with hematogenous dissemination once existed. HAROLD C. OCHSNER, M.D.

Bjerre, H.: Roentgenological Diagnosis of Placenta Previa. *Acta obst. et gynec. Scand.*, 1940, 20: 47.

In examinations by the cystographic method of Ude and Urner, made toward the end of pregnancy in 30 women patients, it was shown that the massive central placenta previa reveals itself by a fairly large, constant fissure (exceeding 2 cm.) between the head of the fetus and the shadow of the bladder, whereas the partial placenta previa cannot be diagnosed with certainty by this method.

Free interspaces, up to 2 cm. in width, are frequently found in normal cases of pregnancy, but in these cases it was possible to eliminate the fissure by photographing the patient in an upright position. This procedure was attended by a manual impression of the fetal head in some cases.

Gascó, Pascual J., and Sala de Pablo, J.: Arthrography of the Knee in the Diagnosis of Trauma to the Menisci (La artrografía de rodilla para el diagnóstico de los traumas meniscales). *Rev. clín. española*, 1940, 1: 137.

The diagnosis of trauma to a meniscus is ordinarily made on clinical examination and is sufficient in most cases in which there is a history of trauma, hydrarthrosis, repeated locking of the joint, joint pain, and impossibility of extending the flexed leg. However, not all cases are so clear cut, and it would be desirable to have some objective means of locating the site of injury, particularly at the present time when sports have become so popular. For accomplishing this purpose either air or opaque substances may be injected into the joint cavity, which is then x-rayed.

In 1905 Werndorff and Robinsohn were the first to practice arthropneumography. The method was revived by Bircher in 1929, and since then there have been numerous variations introduced by various authors in Germany, France, and America. The author uses for this purpose Canigiani's method employing perabrodil (Merck) 35 per cent solution. This solution causes no pain when injected into the joint and after two hours has disappeared completely from the interior of the joint. No secondary joint reactions have been observed after its use.

The author describes his technique of injection: after sterilizing the skin, he inserts a spinal puncture needle into the knee joint medial to the patellar tendon immediately above the internal tibial condyle. After the needle penetrates the knee for from 3 to 4 cm. the author injects 3 c. cm. of the solution of perabrodil, with the needle almost in contact with the tibial spine. After withdrawing the needle, flexion and extension of the joint are done about 12 or 14 times and then an anteroposterior x-ray is taken. The anteroposterior view of the joint is found to give the most information, although at times lateral and oblique views are taken. In the normal cases (Fig. 1) the contrast medium is spread uniformly between the joint cartilages and the menisci. In pathological cases the contrast medium fills the meniscal area (Fig. 2) revealing rupture of the external meniscus. The author presents x-ray reproductions and drawings which illustrate the various pathological types usually found. Of 13

Fig. 1.

Fig. 2.

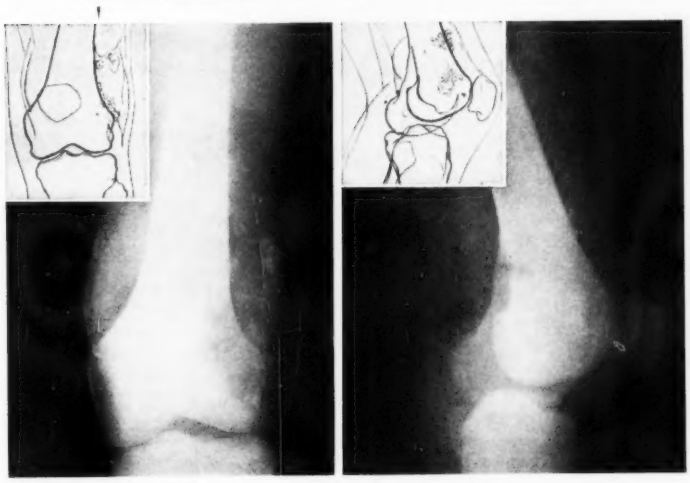

Fig. 1.

patients studied, 7 had rupture of the external meniscus. The findings were confirmed by operation.

JACOB E. KLEIN, M.D.

Lewis, R. W.: Roentgen Recognition of Synovioma. *Am. J. Roentgenol.*, 1940, 44: 170.

The author reports in detail 4 cases diagnosed as synovioma or synovial sarcoma. Roentgenologically they presented a rounded or lobulated sharply defined shadow of a soft tissue tumor mass near a joint, within which scattered and irregular deposits of amorphous lime were found. He believes the appearance to be sufficiently characteristic to justify a provisional diagnosis. In view of the malignant or potentially malignant nature of the lesion, its early recognition is desirable, and the roentgen findings mentioned should serve to render this possible (Fig. 1).

ADOLPH HARTUNG, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Pemberton, J.: A Rapid Method of Differentiating Children with Large or Small Reserves of Vitamin C. *Brit. M. J.*, 1940, 2: 217.

By determining the concentration of Vitamin C as milligrams per 100 c.cm. of urine in a single specimen passed four hours after receiving a test dose of Vitamin C (50 mgm. per stone of body weight), it was possible accurately to differentiate subjects that had been on a high Vitamin C diet and those on a low Vitamin C intake. The former had in every case a concentration of from 15 to 75 mgm. per cent; those on the low diet, from 0.5 to 2.6 per cent. PAUL STARR, M.D.

Tanturi, C. A., and Banfi, R. F.: Prothrombin Studies. The Maintenance of Constant Concentration of Prothrombin in Normal Persons (Estudios sobre protrombina. Constancia de la concentración de protrombina, en personas normales). *Semana méd.*, 1940, 47: 393.

In a previous article the authors described a method of calculation of the concentration of prothrombin circulating in the plasma which utilizes the coagulation time of the blood.

They discuss the advantages and disadvantages of Al $(OH)_3$, and a few other technical details.

The results of their investigations show that the concentration of prothrombin in the blood in normal individuals remains on a relatively constant level. Determinations were made in the same individuals at various times of the same day and also on different days. JOSEPH K. NARAT, M.D.

Andrus, W. DeW., and Lord, J. W., Jr.: Clinical Investigations of Some Factors Causing Prothrombin Deficiencies; Significance of the Liver in Their Production and Correction. *Arch. Surg.*, 1940, 41: 596.

The history of the establishment of a prothrombin deficiency as the cause of the hemorrhagic tendency associated with jaundice and of the significance of Vitamin K in the production of this component of the clotting mechanism is briefly traced.

Clinical experience with crude extracts of substances containing the vitamin and later with the highly potent compound 2-methyl-1, 4-naphthoquinone is reported.

Clinical cases are presented confirming various findings concerning the metabolism of Vitamin K and prothrombin in animals, as reported in a preceding paper. The important rôle of the liver is stressed, and evidence is presented which indicates that damage to this organ may depress the level of plasma prothrombin and seriously interfere with the response to Vitamin K therapy.

Lord, J. W., Jr., Andrus, W. DeW., and Moore, R. A.: The Metabolism of Vitamin K and the Rôle of the Liver in the Production of Prothrombin in Animals. *Arch. Surg.*, 1940, 41: 585.

A brief historical résumé of some of the experimental evidence concerning the relation between the hemorrhagic diathesis, plasma prothrombin, and Vitamin K is presented.

The protective effect on the liver of a carefully selected diet is demonstrated.

Bile must reach the intestinal tract for the proper absorption of the fat-soluble Vitamin K. The essential substance in bile is the bile salts.

In dogs with obstructive jaundice or biliary fistula, bile salts alone when fed by mouth in the absence of added Vitamin K do not suffice to prevent a fall in the level of plasma prothrombin.

Vitamin K after absorption is stored in the liver. Partial loss of the stores of Vitamin K in the liver is reflected in a linear manner by a fall in the level of plasma prothrombin.

The liver is the site of formation of plasma prothrombin. A healthy, normally functioning liver is required for the maintenance of a normal level of plasma prothrombin.

A comparison has been made between the factors of which derangement results in pernicious anemia and the Vitamin K-plasma prothrombin relation. That these two entities are decidedly similar physiologically and anatomically is noted.

Prothrombin is continuously disappearing from the circulating blood, and experiments point to the lung as the site of this loss.

When plasma prothrombin falls to low levels because of inadequate absorption, hepatic damage, or both, the hemorrhagic tendency becomes manifest. The critical level of the plasma prothrombin is approximately 20 per cent of normal by the method used in these studies.

Meiklejohn, A. P.: Is Thiamin the Antineuritic Vitamin? *New England J. Med.*, 1940, 223: 265.

The polyneuritis associated with alcoholism, pregnancy, and gastro-intestinal disturbances is unquestionably due to nutritional deficiency, and is in every way similar to the polyneuritis of Oriental beriberi. However, contrary to numerous statements in recent literature, it has not been demonstrated that this polyneuritis is due to the deficiency of thiamin.

For this reason it is of paramount importance that the treatment of nutritional polyneuritis should include an ample and nutritious diet, together with the administration of such preparations as yeast and crude liver extract to ensure an adequate supply of the entire Vitamin B complex. The efficacy of this treatment has been established by sound clinical experience. Sometimes additional thiamin is bene-

ficial, particularly in the cure of the cardiovascular disturbances of beriberi, and in the relief of the muscular pain and weakness which frequently accompany nutritional polyneuritis.

Rudy, A.: An Unusual Case of Deficiency Disease in a Patient with Diabetes Mellitus. *Endocrinology*, 1940, 27: 206.

A diabetic patient with diarrhea and ulcerating blisters of the skin was cured by the administration of large doses of Vitamin B and nicotinic acid.

PAUL STARR, M.D.

Crandon, J. H., Lund, C. C., and Dill, D. B.: Experimental Human Scurvy. *New England J. Med.*, 1940, 223: 353.

A normal active adult placed himself on a Vitamin C-free diet supplemented by the other known vitamins for a period of six months. The findings in this state of pure Vitamin C deficiency, that is, in the absence of factors such as multiple avitaminoses, infection, growth, or other stress, were as follows:

One hundred and thirty-two days of a diet totally deficient in Vitamin C were required for the first abnormal clinical signs—hyperkeratotic papules—to appear; 161 days were necessary for the appearance of the perifollicular hemorrhages of scurvy.

The plasma-ascorbic-acid level was zero for thirteen weeks before the first evidence of clinical scurvy was manifest. It is not necessarily, therefore, a good index of the Vitamin C status of the individual.

The vitamin level in the white-cell-platelet layer of the centrifuged blood was a good index of the Vitamin C status of the subject. This level fell to zero shortly before the appearance of clinical scurvy.

Adequate wound healing of an aseptic incision occurred after the plasma-ascorbic-acid had been zero for forty-four days and when the white-cell-platelet ascorbic-acid level was 4 mgm. per 100 c.cm. This was after the subject had been on the diet for three months.

With total Vitamin C deficiency, failure of wound healing occurred in a second incision made after six months on the diet. The tissues under these circumstances showed microscopically a lack of intercellular substance. Parenteral Vitamin C alone brought about good healing, and considerable intercellular substance appeared within ten days.

Hyperkeratotic papules containing ingrown hairs appeared over the buttocks and posterior aspects of the legs as a result of Vitamin C deficiency; indeed, they may be the first sign of such a deficiency.

There were no gross changes in the gums or teeth (with good pre-existing oral hygiene). Although the mouth was grossly negative, x-ray films of the teeth showed interruptions of the lamina dura in early acute scurvy. Such an x-ray picture may be one of the better diagnostic criteria in early scurvy.

Vitamin C deficiency did not produce anemia.

After prolonged Vitamin C deficiency there was inability to perform aerobic work, although the capacity for anaerobic work was undiminished. After a period of aerobic work in the scorbutic state the rate of disappearance of the blood lactate was abnormally slow.

During a six-month period of total deficiency and after a month of clinical scurvy the blood-complement titer was still normal. Over this period there was no evidence of lowered resistance to infection.

The Goethlin, Dalldorf, and Ruempel-Leeds tests were negative, even in the presence of frank scurvy. These tests must, therefore, be poor indices of subclinical scurvy, even though they may produce petechiæ which are cleared up by ascorbic-acid therapy.

With severe Vitamin C deficiency there was a fall in the blood pressure.

There was a lowering of the total phosphorus content of striated muscle, with an increase in the phosphagen phosphorus.

All the signs and symptoms of scurvy rapidly disappeared following the intravenous injection of ascorbic acid.

When the state of deficiency was complete the plasma-ascorbic-acid level fell to zero in five hours after the injection of 1 gm. of the vitamin.

Although the blood became completely saturated (as measured by plasma saturation curves and white-cell-platelet levels) after 3 or 4 gm. of ascorbic acid had been given intravenously, the tissues were not completely saturated at this time, since the urinary output of ascorbic acid was still well below the maximal over a six-hour period.

Petri, S., Nørgaard, F., and Bandier, E.: Studies on the Causation of Experimental Gastroprival Pellagra. *Acta med. Scand.*, 1940, 104: 245.

The studies published in 1938 and 1940 by Petri and his associates demonstrated that the parenteral administration of nicotinic acid had no effect on experimental pellagra after gastrectomy. In this article this observation has been extended with a similar conclusion with regard to parenterally administered Vitamin B_1, riboflavin, and Vitamin A. The experiments were carried out in gastrectomized swine. Pathological changes in the blood count, adrenal and thyroid glands, bone marrow, and central nervous system were found. The parenteral route of administration excludes change in intestinal absorption as an explanation of the negative results.

Considering the interaction and transitions that may be observed between pellagra, beri-beri, and alcoholic polyneuritis, clinically as well as experimentally, the thought naturally suggests itself that perhaps there may be some gastrogenous etiological connection between the three lesions. The administration of human stomach juice, or dried swine stomach (ventriculin) plus hydrochloric acid has proved beneficial to patients suffering from pellagra and alcoholic polyneuritis in those instances in which the conditions were refractory to peroral vitamin therapy. Hence the importance of gastric function in the production and therapy of these diseases must be considered.

PAUL STARR, M.D.

Koster, H., and Shapiro, A.: Serum Proteins and Wound Healing. *Arch. Surg.*, 1940, 41: 723.

The authors report the concentrations of total protein, albumin, and globulin, and the calculated protein oncotic pressure of serum in the cases of 58 patients whose operative wounds were carefully observed.

In general, patients who had deep infection or disruption of their wounds showed lower values for total protein and for oncotic pressure in their serum. This was due mainly to a diminution in the albumin fraction.

The finding of normal concentrations of serum protein and albumin in some patients with infected or disrupted wounds, and of relatively low concentrations in some with clean wounds implies that hypoproteinemia by itself is neither a necessary nor a sufficient condition for the development of wound infection or disruption. However, the similarity in the concentrations of total serum protein and serum albumin and in the serum protein oncotic pressures in the groups with deep infection and wound disruption suggests the idea that the poor nutritional state, of which hypoproteinemia is a manifestation, may favor both the development of deep infection and the disruption of clean wounds.

SAMUEL H. KLEIN, M.D.

Parsons-Smith, B.: Pulmonary Embolism and Infarction. *Brit. M. J.*, 1940, 2: 179.

It is generally known that pulmonary embolism and infarction should be regarded as major circulatory emergencies, and although these conditions are still, more often than not, unsuspected or in doubt until post-mortem examination, there is fortunately good reason to assume that other clinical features have in recent years become clearly defined, and in consequence the percentage of correct diagnoses has increased materially.

A large variety of factors are concerned in the formation of the thrombus from which the embolus originates, and the more important of these can best be exemplified by reference to typical postoperative cases. In such cases it is possible to trace primary factors and contributory causes. The former include local trauma to the tissues and blood vessels, and the presence of organisms; the latter comprise several morbid developments as follows: (1) slowing of the blood stream, induced partly by recumbency and diminished muscle action, also partly by constricting bandages and postoperative immobility, and by the shallow respiration which impairs aspiration from the greater veins of the chest and abdomen; (2) chemical and physical changes in the blood—for example, dehydration with concentration of the stream and an increase of the fibrinogen, the calcium content, and the platelet count; and (3) localized areas of injury in the vascular endothelium.

In a certain number of cases an embolus is immediately fatal; in others, a characteristic series of signs and symptoms may be observed for varying periods before death, the patient being suddenly seized with urgent breathlessness, faintness, and feelings of alarmingly severe substernal oppression which tend to persist in spite of treatment. The physical examination discloses the shock syndrome in its entirety. Characteristic signs include pallor, sweating, lividity, and dilated pupils; the pulse is rapid and soft, and the blood pressure considerably lowered; the respiratory rate is accelerated and its excursion usually much diminished; collapse, often ushered in by uncontrollable vomiting, deepens, and unconsciousness as a general rule precludes the fatal issue.

PAUL MERRELL, M.D.

Turell, R., Marino, A. W. M., and Nerb, L.: Studies on the Absorption of Sulfanilamide from the Large Intestine. *Ann. Surg.*, 1940, 112: 417.

In order to determine whether sulfanilamide is absorbed directly from the colon, or whether it passes into the ileum and is absorbed there, the authors used a subject who had no communication between the small bowel and the colon as the result of a permanent ileostomy with exclusion. After the rectal administration of 14 gm. of sulfanilamide over a period of about sixty-five hours the blood showed a concentration of 15 mgm. of combined sulfanilamide per 100 c.cm.

In the investigation of the absorption of the drug from the rectum a patient was utilized who had had a resection of the sigmoid for carcinoma. After the administration of 18 gm. of sulfanilamide in solution into the rectal pouch over a period of three days, the concentration in the blood was 11 mgm. of combined sulfanilamide per 100 c.cm. The absorption of the drug from the rectum and colon when given in suppository form was also studied. Sulfanilamide was absorbed from the rectum and colon when given either in solutions or in suppositories. High concentrations in the blood were noted after the rectal administration of the drug in solution. The rectal route is recommended whenever the oral route cannot be utilized. The same total dosage may be used for the rectal as for the oral administration.

WALTER H. NADLER, M.D.

Tragerman, L. J., and Goto, J. M.: Fatal Reactions to the Administration of Sulfonamide Drugs. *J. Lab. & Clin. Med.*, 1940, 25: 1163.

Five deaths from sulfanilamide preparations are reported from the pathology service of the Los Angeles County Hospital. Three were due to granulocytopenia, 1 to hemolytic anemia, and 1 to liver and kidney damage. Granulocytopenia developed in a patient with scarlet fever who received 101 gm. of sulfanilamide and in another patient who received 64 gm. for streptococcal sore throat. The third patient had been given 88.5 gm. of sulfapyridine in the treatment of bacterial endocarditis. In the 2 instances in which the bone marrow was examined at necropsy, maturation arrest of the myeloid series occurred at the myelocyte level. Acute hemolytic anemia appeared within three days in a patient with

erysipelas who received 25 gm. of sulfanilamide. In this case interference with renal tubular function by precipitated hemoglobin derivatives was considered a major factor leading to death. Clinical evidence of severe liver and kidney damage was observed in 1 patient with gonorrheal arthritis after the administration of 34 gm. of sulfanilamide. Degeneration of the hepatic cells and necrosis of the renal tubular epithelium were found at autopsy.

WALTER H. NADLER, M.D.

DUCTLESS GLANDS

Kepler, E. J., and Randall, L. M.: Fundamental Concepts in Endocrine Diagnosis and Therapy. *Med. Clin. North Am.*, 1940, 24: 941.

In many respects the glands of internal secretion are similar to chemical factories. Raw chemical materials are brought to the glands, and new compounds are manufactured and transported elsewhere for use. These new compounds, known as "hormones," set up specific types of physiological activity in cells or receptors which have the capacity to respond to their presence. In the main there are two types of hormones. Hormones of the first type influence primarily intracellular and extracellular chemical reactions and thereby serve to keep the chemical interchanges of the body constant within physiological limits. Hormones of the second type coordinate the function of certain cells and organs with other organs or with the needs and activities of the organism as a whole.

Diseases of the endocrine glands are usually, but not always, accompanied by quantitative changes in the secretory activity of the diseased organ. In some cases there is evidence that the gland synthesizes an abnormal chemical molecule with properties that may differ materially from those of the normal hormone.

Organic endocrine diseases are usually associated with structural changes in the gland at fault:

1. Glandular hyperfunction is usually associated with (a) diffuse hyperplasia or hypertrophy of the entire gland, or with (b) adenomatous or malignant tumors.

2. Primary glandular hypofunction is frequently found with (a) hypoplastic lesions, or (b) destructive lesions of the glandular parenchyma.

Most of the glands have relatively large factors of safety, so that most of the parenchyma has to be destroyed before symptoms of hypofunction appear. Furthermore, there is evidence to suggest that, as progressive lesions destroy more and more of the gland, the residual healthy glandular tissue compensates by becoming hypertrophic. Secondary glandular hypofunction results from anterior pituitary insufficiency, which may follow an organic lesion of the pituitary body, metabolic disorders, poor hygienic conditions, or systemic disease elsewhere in the body.

Adenomas without clinical evidence of hyperfunction are frequently found at necropsy. This finding does not imply that such adenomas were not functioning. It usually does signify that the sum total of hormone that was made by the adenomatous and non-adenomatous tissue was not excessive.

The outstanding characteristic of hyperfunctioning adenomas is their tendency to function irrespective of the needs of the body. Apparently, they are not inhibited by the normal mechanisms that regulate glandular secretory activity.

When adenomatous tissue hyperfunctions, the remaining non-adenomatous glandular tissue from which the adenoma was derived tends to hypofunction and may become functionally inadequate or even atrophic. Such atrophic tissue usually regenerates if the adenoma is removed, but until regeneration or renewal of function does occur there may be a period in which the body suffers from an inadequate supply of the hormone that had been manufactured by the adenoma.

With few exceptions, the effective treatment of hyperfunctioning lesions is surgical. If the lesion is a benign or operable neoplasm, the surgical removal of the tumor usually results in cure. On the other hand, if the lesion is hyperplastic, the surgical reduction of the mass of hyperplastic tissue is less likely to be of benefit except in cases of exophthalmic goiter. If surgical treatment is inadvisable, roentgen therapy may reduce the mass of hyperfunctioning tissue.

Attempts to depress the hormonal output of hyperplastic or neoplastic tissue by the administration of large amounts of a hormone that is thought to be antagonistic to the diseased gland have yielded either unsatisfactory or equivocal results.

If an endocrine gland is destroyed or incapacitated by disease, the resulting symptoms of hypofunction usually can be controlled by the administration of its hormone. Replacement therapy should be sharply distinguished from stimulating therapy. The former is indicated when an endocrine gland is hopelessly damaged; the latter, when a gland is anatomically capable of functioning but for various reasons does not do so. Replacement therapy should not be used indiscriminately. It does not stimulate either a normal or a diseased gland to produce its own hormone, and as a general rule, therefore, it should not be administered when the objective is an increase in the ability of a gland to deliver its own product. In fact, long-continued administration of a hormone in large amounts may actually inhibit the secretory activity of any healthy tissue which is secreting that hormone, so that the end-result is a situation comparable to disuse atrophy.

Cerviño, J. M., and Pérez del Castillo, C.: The Growth Hormone in the Treatment of Infantile Hypopituitarism with Delayed Growth (La hormona del crecimiento en el tratamiento de los hipopituitarismos infantiles con retrasos graves de la talla). *An. Fac. de med. de Montevideo*, 1940, 25: 536.

The growth hormone secreted by the eosinophil cells of the anterior lobe of the hypophysis has been

isolated and purified by various investigators. These preparations have been tried on hypophysectomized rats and have been found to induce a gain in weight of from 20 to 50 gm. after twenty days. The effect of this hormone diminishes with increasing age of the animal. Its injection for several months into young dogs caused a definite increase in the growth of bone and muscle, as well as other organs without any noteworthy effect on the genitalia. Frequently a glycosuria was observed, and even a true diabetes, which disappeared after cessation of the treatment. The production of the growth hormone in the human being is greatest in the first three years of life, but persists abundantly during youth and adolescence as well as in the acromegaloid tendency of pregnancy. In the present state of our knowledge it is practically impossible to determine whether this hormone action is effected directly on the cells or through the intermediate action of other endocrine glands. Some authors consider the thymus the intermediate gland. The thyroid accentuates the effect of the hormone, although excision of the thyroid gland does not nullify the action of the hormone. The authors emphasize that all organic cells have the faculty of growth and reproduction. This faculty is stimulated and controlled by the hormone secreted by the eosinophil cells of the anterior hypophysis.

The isolation of this hormone by Evans and Long in 1921 opened up new horizons in the treatment of pituitary dwarfism. The authors review briefly the literature on the clinical application of the growth hormone thus far. Their own studies based on a series of more than 15 cases are less favorable than the literature would indicate thus far. The age of the authors' patients varied between eight and seventeen years. The duration of treatment was from several months to one year. The authors report briefly on 4 cases of pituitary dwarfism. Antuitrin C was used for treatment. The duration of treatment was between six months and a year. In this group the growth hormone by itself produced no definite improvement in growth; the only improvement was observed in a case of mixed glandular type in which thyroid administration caused definite growth, even without the administration of the growth hormone. However, the patients gained in weight and improved in their subjective reactions.

In the case reports of results obtained after several years' treatment as found in the literature the author points out that even in pituitary dwarfism there may be periods of spontaneous growth. He reports in detail 1 such case in which there was considerable growth in the prepuberty period before any endocrine treatment had ever been given to the patient. Since the usual period of treatment for such cases is for a number of years, the authors indicate the fallacy of ascribing all improvement to the administration of the growth hormone.

The authors note that the growth hormone produces its most marked curative effects before the age of three years. In this age group the authors had 5 patients, including a pair of fourteen-month-old female twins, and a seventeen-month-old female Mongolian idiot. A definite stimulation of growth was observed in these patients. It was noteworthy that the weight curve fluctuated markedly. The appetite was enormously stimulated, in some cases amounting to boulimia. With the exaggerated appetite there was also noted the frequent occurrence of gastro-intestinal disturbances such as vomiting and diarrhea. Graphic illustrations are presented to summarize the results of treatment with growth hormone in the 5 patients under three years of age.

JACOB E. KLEIN, M.D.

Westman, A.: Clinical and Experimental Studies of Hypophysis Transplants (Klinische und experimentelle Untersuchungen ueber Hypophysentransplantationen). *Acta obst. et gynec. Scand.*, 1940, 20: 118.

Ovarian hormone and, recently, gonadotropic hormones have been used in the treatment of amenorrhea with varying results. In many patients this therapy has yielded either no or only temporary (substitutive action) results. Encouraged by the successful results reported by Bergmann and others, following transplantation of the hypophyseal glands obtained from calves, the author undertook a clinical study in an attempt to explain these results. Animal experiments dealing with this problem have yielded extremely variable results.

Haterius, working with guinea pigs, reported that the ovaries in the animals in which the transplantation of pituitary tissue had been successful showed the presence of follicles of varying sizes but no evidence of ovulation or luteinization. The transplant, therefore, exerts a gonadotropic A-effect but the B-effect is lacking. The absence of the B-effect is attributed to the fact that the transplanted pituitary tissue has no connection with the brain and is, therefore, not subject to the regulatory action of the sexual center (supposedly in the midbrain), which controls the production of the gonadotropic hormone.

A series of hypophyseal transplants carried out in rats which had been hypophysectomized led to ovarian atrophy in all of the animals although microscopic studies showed that the transplants had successfully survived. It was observed, however, that the hypophysectomized animals with transplants appeared to be in better general condition than those in whom no pituitary tissue was transplanted.

A transplant of hypophyses obtained from freshly killed calves was undertaken in 10 cases of amenorrhea (3 primary, 7 secondary). In each case 2 hypophyseal glands were implanted in the labium majus. Eight of these patients showed no results. In 2 menstruation appeared. It should be noted, however, that these 2 cases differed from the others because in addition to amenorrhea both of them had exhibited other endocrine disturbances which were favorably influenced by the hypophyseal transplant. In these cases, the transplant had evidently stimulated the patient's own pituitary gland to stronger

activity in a manner not possible with the usual hormone therapy.

The author did not have an opportunity to determine whether the transplanted glands had successfully survived. Therefore, he is of the opinion that this procedure should be termed hypophyseal transfer rather than transplant.

HARRY A. SALZMANN, M.D.

Blumenthal, H. T.: The Effect of Fresh and Experimentally Modified Anterior Lobe of the Hypophysis of Cattle on the Mitotic Activity in the Adrenal Cortex of the Guinea Pig. *Endocrinology*, 1940, 27: 486.

The implantation of fresh anterior lobe of the hypophysis of cattle into immature female guinea pigs causes an increase of mitotic activity in the adrenal cortex of these animals. If an acid extract of the hypophysis is injected or if the hypophysis is injected after it is immersed in 95 per cent alcohol, acetone, glycerine, or 50 per cent urea, or after it is treated with combinations of urea and glycerine, a similar but less marked increase in mitotic activity is observed. If the cattle gland is immersed in both urea and 95 per cent alcohol, little or no increase in mitoses occurs. This result is attributed to the fact that 50 per cent urea extracts a part of the hormone which is responsible for increased mitotic proliferation. If the cattle gland is treated with acetone or saturated ammonium sulfate before immersion in urea, this extractive effect of urea is diminished.

The authors find that mitotic activity in the adrenal cortex is a more sensitive indicator for the effect of certain hormones than is a study of weight changes in the gland. EDWARD W. GIBBS, M.D.

Fels, E.: Experimental Investigations on the Interchange of Sex Hormones in Parabiosis. The Quantity of Hormones Necessary for Interchange (Investigaciones experimentales sobre el intercambio de las hormonas sexuales en la parabiosis. Las cantidades hormonales necesarias para el intercambio). *An. Fac. de med. de Montevideo*, 1940, 25: 600.

Parabiosis, particularly celio-anastomosis (the union of both abdominal cavities) is the most intimate experimental communication of two organisms which guarantees the greatest possible humoral exchange. For this reason the author has frequently used this method to study certain biological problems in the activity of sex hormones.

He has found that in animals of the same sex the sex glands and functions are not influenced by parabiosis, because the normal amounts of hormones secreted by each animal are not sufficient to influence the other animal. For the same reason, in parabiosis the castrated rat is not influenced by the sex hormones of the normal animal. The gonad-stimulating hormones of the anterior hypophysis are more readily transmitted to the companion animal than the estrogenic hormones. The author reviews the pertinent literature on this subject. There is considerable divergence of opinion as to the activity of follicular hormone in parabiosis. The author carried out some quantitative studies to clarify some of these divergent opinions. He made 17 experiments on 5 pairs of parabiotic animals. Quantitative studies show that estrogenic hormone passes from one animal to the other only if a minimum of from 800 to 1,000 units is injected; also the same amount injected in fractional doses exerts a greater effect than if it is injected in one large dose. To induce estrus in both parabiotic animals it takes more than twice as much as the amount required to induce estrus in each individual animal—usually four or five times as much is required. This is explained by the fact that the hormone in passing through the first animal is inactivated by the liver and the reticulo-endothelial system of the first animal. The gonadotropic hormones are not destroyed in passage and therefore pass over very readily to the other animal in the parabiosis.

The author carried out a similar series of studies on 13 pairs of parabiotic animals—normal males, castrated males, normal immature females, and castrated females—in the study of the effect of male sex hormone (testosterone propionate). In females 5 mgm. of male hormone was sufficient to cause an effect; but this was inadequate in males. This is explained by the author as being due to the ease with which sex reactions are observed in the vagina, as compared with the difficulty of observing such changes in the male. The author presents tables and photomicrographs in illustration of the data and findings of his experiments.

JACOB E. KLEIN, M.D.

Fels, E.: Experimental Investigations on the Interchange of Sex Hormones in Parabiosis. The Effect of Transplanting the Testes (Investigaciones experimentales sobre el intercambio de las hormonas sexuales en la parabiosis. El efecto hormonal del testículo transplantado). *An. Fac. de med. de Montevideo*, 1940, 25: 610.

The author reports a series of 9 parabiotic experiments in which 2 male animals were united surgically in the dorsal region, instead of in the abdominal region as in previous experiments. One of the couple was castrated and the testes of the other were transplanted into the scrotum of the castrated animal by means of a pedicled graft, the deferent duct and spermatic vessels being used.

In all of the instances atrophy of the genitalia was observed in the castrated animal. Microscopic study of the hypophysis showed the changes usually found in castrated animals. The hypophysis of the other animal, which furnished the testes transplant, was normal. In all of the cases there was more or less degeneration noted in the transplanted testes.

The author concludes that in spite of transplantation of the testes the male sexual hormone acts only on the normal animal, without any influence on the castrated animal. He points out that in transplantation experiments the testes are more sensitive to

trauma and toxemia than the ovaries. In previous experiments the author demonstrated that the ovary transplanted into a castrated female animal acts the same way as has been indicated. He concludes that the gonads of both sexes conduct themselves in the same way as concerns their hormonal function in parabiosis. JACOB E. KLEIN, M.D.

Siegler, S. L.: Further Experiences with the Hormone of Pregnant-Mare Serum. *Endocrinology*, 1940, 27: 387.

The author has produced ovulation in the rabbit, immature monkey, and human being by the use of the hormone of pregnant-mare serum. The ability of this hormone to stimulate ovulation has been confirmed by the study of repeated endometrial biopsies, vaginal smears, and urinary analyses for sodium pregnandiol glycuronidate. The effect produced by injection of the serum is similar to that of the normal gonadotropic secretion of the anterior pituitary gland. EDWARD W. GIBBS, M.D.

Drips, D. G., and Osterberg, A. E.: An Evaluation of a Colorimetric and a Biological Method for Determining Urinary Androgens. *Endocrinology*, 1940, 27: 345.

Because of an increased interest of clinicians in testosterone as an aid to treatment in gynecology, it seemed advisable to try to find some simple method for the determination of the content of androgens in the urine, which we might use in certain cases in which there is clinical evidence of endocrinological dysfunction.

Because of its simplicity the colorimetric method of Oesting with Hellige's colorimeter was used. The color is expressed directly in color units read from the color disc of the colorimeter and the number of color units in a twenty-four-hour specimen of urine is calculated.

The biological method used for the determination of urinary androgens requires the selection of 3 littermate male rats twenty-one or twenty-two days old. The testes are removed from 2 of these animals, the third being used as a normal litter-mate control. Ten days after castration injections are started on the experimental animal. One castrated animal is used as an uninjected castrated control. Five-tenths of one cubic centimeter of urine extract is injected twice daily for seven consecutive days, which makes a total of 7 c.cm. of extract. The rats are killed on the day following the last injection or at thirty-eight days of age. The seminal vesicles and prostate gland are removed. In the rat the anterior portion of the prostate gland is made up of two lobes, one lobe lying within the fascia of each seminal vesicle. This portion of the prostate gland is weighed with the seminal vesicles. Extraneous connective tissue and fat is removed from the seminal vesicles and the two are weighed together. The posterior portion of the prostate gland is separated from the middle part and each lobe is weighed separately. All free tissues are fixed in Bouin's fluid. One seminal vesicle and the posterior portion of the prostate gland are imbedded in paraffin, sectioned, and stained with hematoxylin and eosin preparatory to histological examination.

The degree of androgenic activity of the injected extract is determined by the state of the secretory tissue in the seminal vesicle and posterior lobe of the prostate gland of the animal receiving the extract. The indicators of the hormonal activity in the test extract are two: the gross weight of the animal organs and the histological aspects of the organs. It has been found that a dosage of 0.5 mgm. daily will bring about a response in the epithelium of the seminal vesicles which correlates reasonably well with that of the normal thirty-eight-day rat. The epithelium of the prostate is brought up to a little better than normal by this same dosage. Both these organs will respond to stimulation in excess of the normal response for their age. The degree above and below the normal is determined by comparison with androsterone standards.

Our biological determinations are expressed in terms of crystalline androsterone. It has been difficult to correlate these with the color units, but it would seem that the biological reaction to 1 mgm. of androsterone might be equivalent to about 50 color units. There is apparently considerable chance for error arising from both methods. There seems to be less variation in the content of androgens from day to day in the same individual as determined by the biological method than there is as determined by the colorimetric method. The colorimetric method will certainly determine the presence of androgenic material and will serve as a guide at least for biological assays.

The best test of any method is to evaluate it from the clinical standpoint. The content of estrogens and androgens in the urine of normal adult men and women was studied first. In males there would seem to be less variation in the androgen content from day to day than in females. We have not found any definite cyclic excretion in the normal female although there tends to be an increase in excretion premenstrually. The average of the twenty-four-hour amounts of androgen in males was 9.3 mgm. based on 17 determinations in different individuals. In females, the average was 7.4 mgm. based on 26 determinations, the highest being 16.1 mgm. and the lowest 2.5 mgm.

After working out our standard in the normal, a group of abnormal men and women was studied. This group of patients is still too small to serve as a basis on which to formulate any conclusions, but the results would seem to justify the methods used.

It would appear, therefore, that the epithelium of the seminal vesicles of the immature castrated rat can be used to advantage in a method for determining amounts of male hormone in the urine, and that Hellige's colorimeter method, which is much simpler than the biological method, may also be used. Both methods are crude but approximately exact enough to be used as clinical guides for treatment.

Hooker, C. W., Gardner, W. U., and Pfeiffer, C. A.: Testicular Tumors in Mice Receiving Estrogens. *J. Am. M. Ass.*, 1940, 115: 443.

During the course of prolonged treatment with large amounts of estrogen, the glandular interstitial tissue of the testes in mice of the Strong A strain was observed to hypertrophy to such an extent that large areas of the testes were composed entirely of these cells. In the absence of local invasion or of metastases these overgrowths were not considered malignant.

However, a large interstitial-cell tumor of the testes which metastasized to the lumbar and renal lymph nodes developed in a mouse of the A strain which had received weekly subcutaneous injections of 0.05 mgm. of estradiol benzoate for a period of two hundred and sixty-four days. Histologically, the testicular tumor and the metastatic lesions were identical and revealed unquestionably malignant characteristics.

A large tumor of the glandular interstitial cells also developed in 1 mouse of the A strain which had received 250 micrograms of stilbestrol weekly from the thirty-sixth to the two-hundred-and-eightieth day of life. This tumor was slightly smaller, measuring 10 mm. in diameter, but it was almost identical histologically with the tumor in the mouse treated with estradiol benzoate and was unassociated with metastases; it was therefore considered to be malignant.

ANTHONY F. SAVA, M.D.

EXPERIMENTAL SURGERY

Shumacker, H. B., Jr., Firor, W. M., and Lamont, A.: Toxin-Antitoxin Reactions in Experimental Tetanus. *Bull. Johns Hopkins Hosp.*, Balt., 1940, 67: 92.

The authors have extended previous studies to include the protecting values of antitoxin against toxin introduced intravenously, intramuscularly, intracutaneously, and subcutaneously in both tetanus-resistant and tetanus-sensitive laboratory animals. In this report experimental observations are given along with an appreciation of their significance in relation to certain theories heretofore proposed in the literature.

Certain differences exist in the protecting power of antitoxin against toxin introduced by various routes. When toxin and antitoxin are mixed *in vitro* and then injected intramuscularly a unit of antitoxin is capable of protecting against from 1.5 to 9 times more toxin than when the two are injected separately into the veins. This may mean that when there is present in the blood stream of an animal a certain amount of toxin and an excess of antitoxin as measured by the *in-vitro* protecting value, neutralization of each molecule of toxin in the blood stream is not instantly and completely effected, which permits a portion of the toxin to escape and become fixed in the body tissues where it is at first more difficult to neutralize and eventually cannot be neutralized. While it was long thought that once toxin became fixed it could no longer be neutralized it has been shown that toxin can be neutralized by antitoxin up to a certain point in the period of incubation and that this antitoxin must be present in great excess to accomplish this end.

The observation of the authors shows further that the antitoxin delivered into the blood stream is less effectual against toxin injected intradermally, subcutaneously, or intramuscularly than against toxin injected intravenously. The differences in the protecting power of antitoxin against toxin introduced by various peripheral roots are not great. When toxin is injected into muscle, skin, or subcutaneous tissue from 4 to 20 times more antitoxin is required for neutralization than after the intravenous injection of toxin. A very great difference is noted when we compare the protecting power of antitoxin against toxin placed directly in the lumbar cord with the protecting power of antitoxin against toxin given intravenously. When injected into the blood stream a unit of antitoxin will protect against 7,000 times as many guinea-pig-median lethal doses as when the toxin is placed in the lumbar cord.

It was shown further that in experiments in which antitoxin is injected intravenously the amount of toxin neutralized in any one species should be proportional to the amount of antitoxin given or to the concentration of antitoxin in the blood stream. Concentration of the toxin after it has been injected into the muscle or the skin is not known.

The authors finally point out that antitoxin is more effective in tetanus-resistant than in tetanus-sensitive animals. The number of toxin units that are neutralized is least in the very sensitive guinea-pig, greater in the slightly less sensitive mouse, and still greater in the resistant dog or cat. This resistance cannot be explained either by the difference in the lethal dose for each species or by a difference in concentration of the antitoxin.

ANTHONY F. SAVA, M.D.

Bale, W. F.: The Use of Artificially Produced Radio-Active Elements As Tagged Atoms in Biological Research. *Radiology*, 1940, 35: 184.

The author obtained, from Lawrence and Kamen of the Radiation Laboratory of the University of California, radio-active iron in the form of ferric chloride, which he fed to experimental animals. The radio-activity was obtained by bombarding the iron in the cyclotron with deuterons. The isotope activated is the one with an atomic weight of 58, the reaction being: $Fe^{58}+H^{2}\rightarrow Fe^{59}+p$. In a typical sample of radio-iron, this isotope constitutes less than 1 per cent of the total weight of the iron, so that the activity is rather weak. However, with the aid of a Geiger-Muller counter and a specially adapted technique by which quantitative measurements were made in solutions, the author was able to trace the path of this tagged iron in the blood of the animals.

The experiments consisted of feeding aliquots of the radio-iron to (1) anemic and (2) plethoric dogs.

Blood samples were then taken at various intervals, the plasma and cells separated; the iron was extracted and the radioactivity measured with the Geiger-Muller counter in units of so many counts per minute. From hematocrits and blood-volume determinations the concentration of the tagged iron in the circulating blood was finally estimated.

The conclusion is reached that the absorption of the iron is determined by the need of the body. In the anemic dogs the assimilation was prompt, whereas in the plethoric animals the absorption was negligible. The iron was at first largely transported by the plasma, but within a few hours it started to concentrate in the red blood cells and within three days about 7 per cent of the tagged iron was found to be present in the erythrocytes presumably as hemoglobin.

In another series of experiments, it was found that no matter how great a surplus of labelled iron was injected, the dogs had no ability to excrete this material. At present, the author is studying whether the iron which appears in the erythrocytes as early as five hours following feeding is already in the form of hemoglobin or in some other combination.

Other examples of radio-active elements which may be successfully utilized as tracers in biological research are also briefly reviewed. A listing of these radio-indicators according to the ease with which they may be employed gives the following table:

RADIO-INDICATORS

Element	Half Life	Made from	Bombarding Particle
Phosphorus	14.5 days	Sulfur	Neutron
		Phosphorus	Deuteron
Arsenic	14 "	Germanium	Proton
Sodium	14 hours	Sodium	Deuteron
Iodine	8 hours and 8 days	Iodine	Deuteron
		Tellurium	Proton
Selenium	40 days	Arsenic	"
Potassium	13 hours	Potassium	Deuteron
Copper	13 "	Copper	"
Iron	42 days	Iron	"
Sulfur	84 "	Sulfur	"
Fluorine	110 minutes	Oxygen	Proton
Chlorine	37 "	Chlorine	Deuteron
Carbon	20 "	Boron	"

T. Leucutia, M.D.